Retaining U.S. Air Force Pilots When the Civilian Demand for Pilots Is Growing

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Preface

The research discussed in this report was conducted for a project entitled "Pilot Retention Pay Under New Laws." The purpose of the project was to consider how changes in external demand from airline hiring will affect Air Force pilot retention and provide estimates of how modifications to the aviator retention pay (ARP) and aviator pay (AP) programs will influence Air Force pilot retention. To accomplish this goal, this research reviews earlier studies, considers the supply and compensation of airline pilots, and makes an assessment of the future demand for airline pilots. It extends and estimates RAND's dynamic retention model for Air Force pilots and runs simulations to find the effects of increases in airline pilot pay and hiring on Air Force pilot retention and determine the changes in ARP and AP that could offset those effects. It also simulates the effects of eliminating AP for pilots assigned to non-flying positions. This document should be of interest to those concerned with special and incentive pays in the military, and specifically those interested in the effect of the commercial airline industry on Air Force pilot retention.

The research reported here was sponsored by AF/A1P and SAF/MR and conducted within the Manpower, Personnel, and Training Program of Project AIR FORCE.

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Summary

The aviator retention pay (ARP) and aviator pay (AP) programs are key tools that the United States Air Force (USAF) uses to manage the retention of aviators and address external market forces that can affect the retention of military aviators, including changes in the demand for pilots in the commercial airline industry. ARP is received by rated personnel who commit to a multiyear obligation. The amount typically varies with the occupation and length of the obligation incurred. Three common options that have been offered by the Air Force are a three-year contract, a five-year contract, and an until-20-years-of-aviation-service (until-20-YAS) contract at amounts of up to $25,000 per year for pilots. Historically, all rated personnel have received AP, which provides compensation for a career that is more hazardous than most military careers and also acts as a retention incentive. AP provides up to $840 a month for midcareer officers.

However, these two programs are now discretionary under Department of Defense Instruction (DoDI) 7730.67. Consequently, the ongoing use of these programs, the amount budgeted for ARP and AP expenditures, and changes to the allowable amounts payable under these programs must be justified. This means that the USAF needs to be able to anticipate potential changes in pilot retention so that it can ensure that the resources required to maintain pilot inventory at or near desired levels are in place in a timely manner.

Several changes in the commercial airline industry could make it harder for the USAF to retain pilots, which could justify an increase in ARP and/or AP: The commercial airline industry will be hiring pilots in increasing numbers over the next 20 years to replace its aging pilot workforce. In addition, recent changes to Federal Aviation Administration (FAA) regulations on pilot rest and on the number of flying hours needed to qualify for an airline transport pilot certificate could add to this demand.

To ensure that resources are in place, the USAF asked RAND Project Air Force (PAF) to provide information on recent and likely future changes in airline pilot demand and civilian opportunities for USAF pilots, assess whether and how such changes would affect pilot retention in the Air Force, and analyze whether and how much ARP and AP would need to change to sustain pilot retention.

To document indicators of future pilot demand in the airline industry, we reviewed the literature and developed models to project future growth in passenger and cargo miles, which are indicators of the future demand for civilian pilots. We also considered factors related to the sources of pilot supply, as well as pilot pay scales and the annual earnings of pilots. To assess how changes in civilian demand would affect USAF pilot retention, as well as the required increase in ARP to offset those changes, we drew upon and further developed RAND's dynamic retention model (DRM), which has been previously been used to analyze manpower and personnel

policies for the Air Force and the Office of the Secretary of Defense. This document summarizes our analysis.

Changes in Civilian Pilot Opportunities

Future changes in civilian opportunities for USAF pilots will reflect changes in the supply of pilots to the major airlines and changes in demand. We consider each issue separately.

Major airlines hire pilots from many sources, not just the U.S. military. Students (and instructors) at civilian flight schools may later become pilots in regional and major airlines. Major airlines also hire regional pilots and pilots who have been furloughed from other major airlines.

From flight school to the major airlines is the longest path of supply. Regional pilots can move to the major airlines, but it may take several years for flight school–trained pilots to replace them. Military pilots have the training and hours required to qualify for the major airlines, so they are immediately qualified upon separation from the military.

Not all outgoing military pilots will seek careers as civilian pilots. Industries outside the airlines may offer challenging and well-paid career opportunities. Furthermore, there are limitations associated with a career as a pilot. New pilots must work their way up the seniority system as first officers to fly the best routes and schedules and then must do so again as captains. Pilot career mobility is constrained because changing airlines means starting at the bottom rung again. Consequently, opportunities for salary growth are best for military pilots leaving at the end of their active-duty service commitment and worse for those leaving later, such as after a 20-year military career.

In characterizing civilian pay opportunities available to USAF pilots, we considered both pilot and non-pilot pay. We found that average pilot salaries have rebounded almost to the heights observed in the late 1990s, with a particularly sharp increase over the past few years. This sharp increase is consistent with several contract agreements between the pilot union and the major airlines that will increase pilot pay by approximately 17 percent by 2018 over 2014 levels.

We analyzed American Community Survey data on earnings from 2002 to 2012 of full-time, full-year employed veterans with at least four or more years of education in pilot versus non-pilot occupations. Veteran pilots earn more than non-pilot veterans, and their earnings increase faster with age than those of non-pilot veterans. For the DRM, we use the 80th percentile of earnings for veteran pilots as our measure of civilian pilot opportunities available to USAF pilots at major airlines. The 80th percentile roughly maps to the earnings one might expect from the pilot pay scales at the major airlines.

We also reviewed the literature and developed models to address the question of how large airline demand for pilots might grow in the next decade. We considered two main components that affect airline demand for pilots: the trend in civilian pilots leaving the workforce and growth in demand for air transportation.

The aging of the post–World War II baby-boom pilot cohorts in the major airlines, along with mandatory pilot retirement at age 65, implies a dramatic increase in retirements in the major airlines over the next decade. That said, the number of pilots employed by major airlines has been fairly steady since 2004, at around 50,000. To sustain an inventory of 50,000, and assuming a steady 0.5 percent annual attrition rate, hiring at the major airlines must increase

from fewer than 1,200 in 2014 to more than 2,800 in 2024. Thus, civilian pilot retirement leads to the conclusion that demand for pilots by the major airlines will grow over the next decade, in addition to pilot demand coming from predicted airline growth.

To assess aggregate demand for air transportation, we considered the trends in passenger and cargo miles flown. Passenger miles account for about 93 percent of total miles (passenger and cargo). We also considered another possible indicator of demand: passenger and cargo aircraft departures. However, departures have been affected by management actions to limit the number of departures even as passenger miles have increased; therefore, miles are a better indicator of the demand for pilots.

Passenger miles have trended up since 2000, but departures have been relatively flat since then. The average aircraft capacity (seats per departure) has increased, as have the load factor (fraction of seats filled) and the average flight stage length. Using Congressional Budget Office projections of economic growth and assuming that the producer price index will continue its current upward trend, we estimated models that allowed us to project future departures and miles. For instance, we project a 29-percent increase in passenger miles by 2025 but only a 3-percent increase in passenger departures.

We also gathered data on trends in aircraft size, load factor, and stage length, all of which have been increasing. The increases mean that passenger miles per pilot have also been increasing. If these trends continue, they will moderate the growth in airline pilot demand, so demand for pilots will not grow as rapidly as the projected increase in passenger miles.

Modeling USAF Pilot Retention and Simulating Effects of Civilian Pay Changes on Retention

This research builds on several past studies in which we estimated a DRM of military personnel, including USAF pilots. In this study, we extended the DRM for USAF pilots in a number of ways. First, we included data from 1990 to 2012 in our model. Second, we incorporated a new method to model the pilot's choice of a multi-year contract under the ARP program. Pilots who choose a longer contract receive ARP for more years, but while they are under contract, they also forgo the ability to take advantage of better opportunities that might arise during the contract period. Our new method recognizes that the multi-year contract length choice is a nested choice made under uncertainty. The uncertainty arises from not knowing the specific future conditions (e.g., assignments, flying time, deployments) that accompany the choice. This extension requires estimation of an additional parameter in the model, which is related to the variance of the shock associated with the multi-year contract choice. This parameter estimate is statistically significant, indicating that this portrayal of the multi-year contract choice is an improved approach to modeling the ARP/contract choice. Third, we extended the model to consider multiple entry cohorts—specifically, the 1990 to 2000 officer entry cohorts. Doing so permitted us to incorporate changes in USAF ARP policy that occurred in the 2000s and changes in military pay since 1990. It also incorporates features of the civilian pilot opportunities available to USAF pilots who leave the Air Force, garnered from our regression estimation of veteran pilot earnings. Finally, this model uses an expected wage line that is a combination of veteran civilian non-pilot and veteran civilian pilot earnings, where earnings are weighted according to an estimated probability that officers are hired by a major airline. The probability is modeled as a function of the number of major airline hires in a given year. The updated and

extended DRM produces an excellent fit to the actual data, and all of the parameter estimates are statistically significant.

We used the updated and extended DRM to develop a simulation capability that allows us to model how USAF pilot retention would change under an array of scenarios. We first found the effect on pilot retention of an increase in major airline hiring from 1,700 hires per year (corresponding to a probability of an Air Force pilot being hired of 10 percent, which was also the average probability between 2003 and 2013) to 2,900 hires per year (corresponding to a probability of 40 percent). Given uncertainty in future hiring, we also considered increases in hiring ranging from 3,200 hires per year (corresponding to a probability of an Air Force pilot being hired of 50 percent) to 3,800 (corresponding to a probability of 70 percent). Next, we considered an increase in civilian pay—specifically, a 13-percent net increase in external pay for major airline pilots and a 4-percent net increase in civilian non-pilot pay.[1] We also considered the effects of larger and smaller increases in the civilian opportunity wage for pilots. We then estimated how much ARP must increase to sustain retention in the face of changes to the probability of being hired by a major airline and external pilot pay. Finally, we simulated results of a policy that would eliminate flight pay or AP for pilots in non-flying positions. On average, more than a fourth of rated personnel with 11 to 20 years of service are in non-flying assignments.

Figure S.1 shows the simulated steady-state retention effect of an increase in major airline hiring from 1,700 to 3,200 pilots per year, which we estimate would correspond to an increase in the probability of being hired by a major airline from 10 to 50 percent. The figure shows that steady-state pilot retention drops among midcareer and senior career personnel—i.e., among personnel who have completed their active-duty service commitment. Overall, the steady-state pilot force size drops by 6.3 percent. Thus, should an increase in civilian pilot demand lead to a sustained increase in the probability of officers being hired by major airlines, retention would fall by 6.3 percent, or more than 800 pilots, from current end-strength levels, holding accessions and ARP constant.

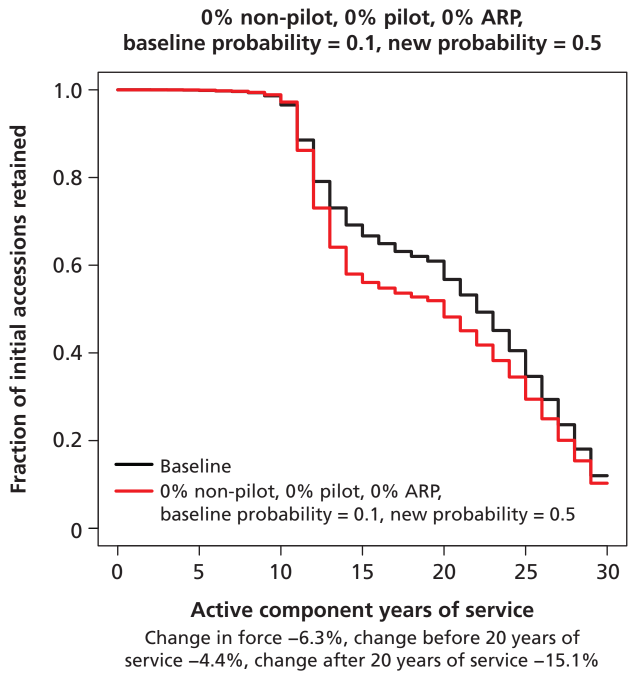
Not surprisingly, a larger increase in the probability of being hired would have a more negative retention effect. A smaller increase has a smaller retention effect.

Similarly, an increase in the wage offered by major airlines would have a negative effect on retention. For example, a 13-percent net increase in pilot pay and a 4-percent net increase in non-pilot pay (as would be the case with a 17-percent increase in real pilot pay, an 8-percent increase in real non-pilot pay, and a real increase of 4 percent in RMC), together with an increase in major airline hiring to 3,200 pilots per year, would result in a steady-state decline in force size of 12.3 percent (or 1,587 pilots).

Assuming that the drop in retention shown in Figure S.1 causes retention to fall short of requirements, how much would ARP have to increase to offset the negative effect of an increase in civilian pay? The DRM simulation capability includes an optimization routine that finds the amount of ARP that minimizes the gap between the retention profile produced by the increase in civilian pay and the baseline. We illustrate this for the case in which major airline hiring increases to 3,200, civilian pilot pay increases by 13 percent net of the percentage increase

[1] The net increase is the difference in the real increase over 2014 civilian wages (either major airline pilot or non-pilot) and military pay as measured by regular military compensation (RMC). For example, a 17-percent increase in real pilot pay, an 8-percent increase in real non-pilot pay, and a 4-percent increase in real RMC would result in a 13-percent net increase in pilot pay and a 4-percent net increase in non-pilot pay.

Figure S.1
Simulated Steady-State Effect on USAF Pilot Retention of an Increase in the Probability of Being Hired by a Major Airline from 10 Percent to 50 Percent (from 1,700 to 3,200 Hires per Year)



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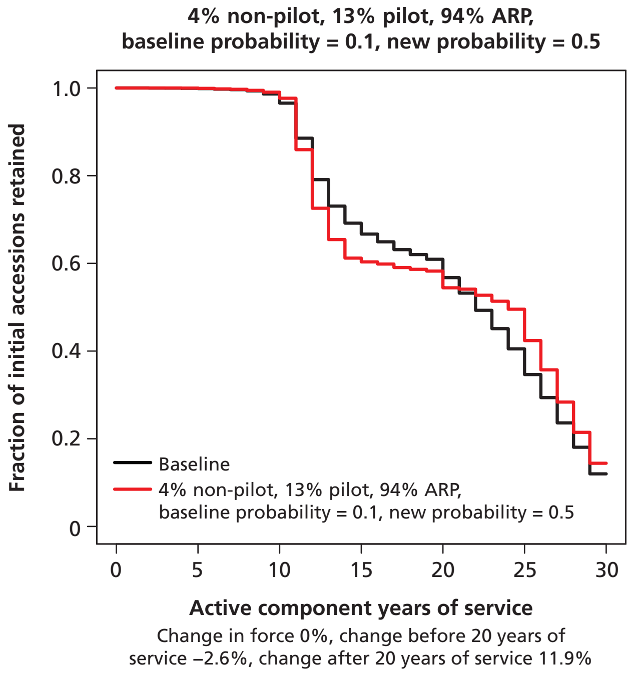
in RMC, and civilian non-pilot pay increases by 4 percent net of the percentage increase in RMC. Figure S.2 shows the steady-state effect of a compensating increase in ARP. In this case, the ARP cap must increase by 94 percent—or must nearly double—to offset the increase in hiring and the increase in civilian pilot pay. Varying the assumptions across the scenarios, we found that an increase in ARP of 54 percent to 151 percent was required to sustain retention. These scenarios correspond to an increase in major airline hires from approximately 2,900 or 3,800 hires per year and a 9- to 14-percent net increase in expected civilian pay for pilots relative to 2014. That is, ARP would need to increase from the current amount allowable by law of $25,000 per year to $38,500–$62,500 per year to cover all scenarios. If the increases in real civilian opportunities are even higher, the increase in ARP would need to be still higher.

Our results do not imply that the USAF should offer higher ARP amounts to all pilots, up to a higher cap level. Whether the USAF should actually offer higher ARP to pilots depends on USAF pilot requirements in the coming years and on whether USAF pilot retention is insufficient to meet requirements. The analysis here argues for increasing the cap as a prudent measure for enabling a rapid response.

The DRM model provides the USAF a capability to consider the pilot retention effects of other compensation scenarios as well as to justify current special and incentive pays or changes in those pays. We demonstrated the broader capability by simulating the retention effects of eliminating AP for pilots assigned to non-flying positions. Pilots in non-flying positions are typically midcareer or senior personnel, but even so, most pilots, even those in their mid- and

Figure S.2
Simulated Steady-State Effect of a Compensating Increase in ARP of an Increase in the Probability of Being Hired by a Major Airline from 10 Percent to 50 Percent (from 1,700 to 3,200 Hires per Year) and a Net Increase in Civilian Pilot Pay of 13 Percent and Civilian Non-Pilot Pay of 4 Percent



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senior career stages, are in flying positions rather than in non-flying positions. For example, after 11 years of service, only about a quarter or more of pilots are in non-flying positions. Currently, AP is paid to those in both flying and non-flying assignments. We simulated the effects of reducing expected overall AP by eliminating AP for those in non-flying positions. We found that pilot force size would drop by 0.9 to 1.1 percent (or from 120 to 140 pilots from current end-strength levels), depending on the probability of being hired by a major airline. The reduction is not larger because the majority of even midcareer and more senior pilots fill flying rather than non-flying positions. That said, the reduction in retention is largest for those with over 13 years of service.

Conclusions

Overall, we found that recent trends in civilian pilot demand and changes in supply will increase the opportunity for USAF pilots to be hired by a major airline, though, of course, projecting the future is uncertain. Assuming an increase in major airline hiring to 3,200 hires per year (corresponding to a probability of being hired of 50 percent), a net increase in civilian pilot pay of 13 percent, and a net increase in civilian non-pilot pay of 4 percent through 2018 relative to 2014, we found evidence to support an increase in the ARP cap from the current

$25,000 per year to $48,500 per year, a 94-percent increase, with a large range, from $38,500 to $62,500, to cover net increases in civilian pilot pay from 9 to 14 percent and an increase in major airline hiring to 3,800 pilots per year (corresponding to a probability of being hired of 70 percent). More broadly, the DRM capability developed here can be used to consider an array of compensation policies for pilots, thereby providing the USAF with an empirically based analytical platform to determine the special and incentive pays or other pay actions needed to sustain retention. It can also be applied to hypothetical scenarios, such as a near-term surge in major airline hiring.

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Abbreviations

ABM	air battle manager
AC	active component
ACCP	aviation career continuation pay
ACIP	aviator continuation incentive pay
ACOL	annualized cost of leaving
ACP	aviator continuation pay
ACS	American Community Survey
ADSC	active-duty service commitment
AFPC	Air Force Personnel Center
AP	aviator pay
ARP	aviator retention pay
ATP	airline transport pilot
BTS	Bureau of Transportation Statistics
CBO	Congressional Budget Office
CFI	certified flight instructor
CPI-U	Consumer Price Index for All Urban Consumers
CRRA	constant relative risk aversion
CSO	combat systems operator
DoDI	Department of Defense Instruction
DOT	U.S. Department of Transportation
DRM	dynamic retention model
ECI	Employment Cost Index
FAA	Federal Aviation Administration

FAPA	Future & Active Pilot Advisors
FY	fiscal year
GAO	General Accounting Office
GDP	gross domestic product
MIT	Massachusetts Institute of Technology
PAF	Project AIR FORCE
PDV	present discounted value
PPI	producer price index
R-ATP	restricted airline transport pilot
RC	reserve component
RMC	regular military compensation
S&I	special and incentive
TAFMS	total active federal military service
USAF	U.S. Air Force
WEX	Work Experience
YAS	year(s) of aviation service
YOS	year(s) of service

CHAPTER ONE

Introduction

Aviator retention pay (ARP) and aviator pay (AP) are the key tools that the U.S. Air Force (USAF) and the other services use to manage aviator retention. ARP and AP can offset internal conditions or external market forces that could decrease retention, including changes in the demand for pilots in the airline industry. The ARP and AP programs are now discretionary under Department of Defense Instruction (DoDI) 7730.67. Consequently, their funding levels must be justified in terms of how each type of pay affects retention.

An important current question is whether an increase in hiring by major airlines will accelerate the outflow of Air Force pilots. A related question is what amounts of AP and ARP could prevent this. More generally, the Air Force needs information and analysis to manage pilot compensation and respond to potential decreases in retention caused by improvements in civilian job opportunities or other factors. A retention risk would occur if the budget allocation for AP and ARP were too low or if the mandated caps on AP and ARP payments were too low.

In addressing these challenges, we assess civilian pilot supply, compensation, and demand, and we use information from this assessment as input for modeling Air Force pilot retention. We use the model estimates to simulate the effects on pilot retention of a range of increases in major airline hiring and pay and to determine the amounts of AP and ARP needed to counteract these increases.

We began by taking a broad view of the airline industry and the pilot labor market but were especially interested in major airlines that we defined as those flying Boeing 700 series or Airbus 300 series aircraft. Positions in these airlines pay well, and flying skill and experience gained in the military is largely transferable to them. Major airlines face a wave of pilot retirements over the next ten years, and this challenge, along with predicted growth in the demand for air travel, will increase their pilot hiring. In addition, pilot pay at the major airlines is rising. The increase in hiring and pay can be expected to attract military pilots, as our empirical results indicate.

We describe the various sources of pilot supply and the number of pilots coming from each source, present data on airline pay scales and near-term pay increases based on recent pilot contracts, and estimate regressions on pilot and non-pilot earnings. We used pilot pay scales and the regression results to identify civilian age earnings curves relevant to Air Force pilots. These curves become input into our pilot retention model.

The retention model draws upon and further develops a RAND modeling capability known as the dynamic retention model (DRM). It has been previously used to analyze manpower and personnel policies for the Air Force and the Office of the Secretary of Defense. The DRM is an econometric model that shows how changes to pay and personnel policies affect active and reserve retention. The DRM can also be used to assess the retention effects of

other compensation policies for the pilot community, such as eliminating AP for pilots who are not assigned to flying positions. To extend the DRM, we incorporated new methods to model pilots' ARP contract length choice and included large airline hiring. We estimated the DRM for Air Force pilot cohorts that entered the service from 1990 to 2000 and that were followed to 2012. We accounted for changes in military pay since 1990 and changes in ARP that occurred in the 2000s, the years after these cohorts completed their initial active-duty service commitment.

Chapter Two discusses earlier studies of military pilot retention and a study that forecasts a looming shortage of civilian pilots. Chapter Three describes the sources of civilian pilot supply, the pilot seniority system, and pilot hiring by the major airlines. Chapter Four discusses average pilot salary, airline hourly pay scales, regressions on the annual earnings of pilots and non-pilots, and pay increases at large airlines resulting from recent labor agreements. It also evaluates the present discounted value of civilian pilot versus non-pilot earnings at different ages. Chapter Five focuses on civilian pilot demand. As an indication of the demand for air travel and air freight, we estimate macro models of major airline passenger and cargo miles and predict miles over the next decade. The chapter also discusses the role of aircraft size, load factor, and flight stage length in moderating the demand for pilots, despite the growth in passenger and freight miles, and describes the coming wave of pilot retirements. The chapter's perspective is that major airline hiring over the next ten years will lie within a range defined by the replacement of retiring pilots and pilot attrition, with the upper end of the range also including hiring related to air transportation growth. Chapter Six discusses our DRM extensions for the pilot community and presents new model estimates. Chapter Seven presents simulations showing how increases in major airline hiring and pay could affect pilot retention and the levels of ARP needed to sustain it. We also present simulation results on how eliminating AP for pilots in non-flying positions could affect retention. Our concluding remarks are in Chapter Eight.

CHAPTER TWO

Selected Previous Studies

We reviewed earlier studies of military pilot retention and a study that forecasts a civilian pilot shortage. For readers broadly interested in the airline industry, *Introduction to Air Transport Economics: From Theory to Applications* by Vasigh, Fleming, and Tacker (2008) presents information on economic concepts of supply and demand, cost and production, aviation operation and ownership, market structure and oligopolistic markets, forecasting, pricing policy and revenue management (e.g., by overbooking), and aviation safety and security. However, the book does not discuss the supply, demand, and compensation of pilots.

Studies of Military Pilot Retention

Gotz and McCall

Gotz and McCall's application of stochastic dynamic programming to Air Force pilot retention, *A Dynamic Retention Model of Air Force Officer Retention: Theory and Estimates* (1984), was pathbreaking. Their dynamic retention model placed the decisionmaker in a multi-period world with uncertainty. The model specified optimizing behavior in each period depending on several factors: the individual's current state, which depended on past choices; the individual's taste for military service; the pay and random events realized in the period; and an assessment of the alternative future paths, the value of which reflected optimal decisions in future periods when the random events in those periods were realized. Gotz and McCall estimated the model on Air Force pilot retention rate data for fiscal year (FY) 1977 through FY 1981. Because the model captured the relationship between compensation and retention over a career, the model could be used to predict the effect of a change in compensation on the retention rate not only at a given year of service (YOS) but also over a career. Gotz and McCall did not pursue the objective of estimating the impact on the career retention profile, however, but did produce predictions of retention changes over a two- to three-year period following the end of the pilot's active-duty service commitment (ADSC). For example, they predicted that a 5-percent increase in pilot pay (consisting of basic pay, allowances, and flight pay) would increase retention in the last year of ADSC—then YOS seven—by 2.2 percent and by 0 percent in the following year. Treating the two years together, retention at years seven and eight was 83 percent at baseline and 86 percent after the pay increase, an increase of 3.6 percent.[1] Gotz and McCall considered a $10,000 aviator retention bonus in 1974 paid in the last year of ADSC

1 Other authors have interpreted this as a pay elasticity of 0.72 (3.6/5.0) at the end of ADSC, but it is a two-year retention response to an across-the-board increase in pay of 5 percent.

that required the pilot to stay until year ten. Four-year retention from years seven to ten was 70 percent at baseline and 73 percent with the bonus, a 2.9-percent increase. This meant that in addition to higher retention in the three-year period following ADSC, the number of personnel making a retention decision at year 10 was 2.9 percent higher. The $10,000 bonus was worth roughly $47,600 in 2014 dollars.[2]

Ausink and Wise

Ausink and Wise (1996) studied the relationship between military pay and retirement benefits and Air Force pilot retention. They used an option value model that they describe as a simplified dynamic programming specification. Their estimation sample consisted of 1,803 officers in the Strategic Air Command or Military Airlift Command in years of service six through 27 in 1987. Pilots in these commands fly large aircraft similar to those in civilian aviation. For comparison, Ausink and Wise used an annualized cost of leaving (ACOL) model and the dynamic programming model of Lumsdaine, Stock, and Wise (1996). The latter is a variant of Gotz and McCall (1984). The ACOL model did not fit the data as well as the option value and dynamic programming models.[3] Both the option value and dynamic programming models predicted lower loss rates of pilots with under 20 years of service upon the introduction of aviator continuation pay (ACP; now ARP). When introduced in 1988, ACP required pilots to remain in the Air Force until completing 14 years of service. The bonus amount was $12,000 per year for a pilot with six years of service, which decreased with seniority to $6,500 per year for a pilot who had completed 12 years of service. The bonus of $12,000 was roughly equivalent to $24,000 in 2014. Unlike our dynamic retention model, the option value model and the Lumsdaine, Stock, and Wise model put an exponent on current income. The estimates of this parameter are greater than one, implying that a 1-percent increase in income has a greater-than-1-percent increase in its perceived value to the individual. This was probably an unexpected and not necessarily welcome result.[4] Also, the option value model includes a parameter on retirement benefits to allow for the possibility that a person may value a dollar of benefits differently than a dollar earned from labor.[5] The option model does not include a variable for taste for the military but instead includes an error term that is allowed to be automatically

[2] The Consumer Price Index for All Urban Consumers (CPI-U) was 50.0 in August 1974 and 237.85 in August 2014, an increase of 4.76 times (U.S. Bureau of Labor Statistics, 2014a).

[3] These models both fit the data well up to 20 years of service. The dynamic programming model underpredicted the loss rate at 20 years of service and overpredicted it in following years. The option value model predicted the loss rate at 20 years of service accurately but overpredicted it in the following years.

[4] The use of an exponent on income reflected the choice to specify a constant relative risk aversion (CRRA) utility function. This function generally has the form

$$u(c) = \frac{1}{1-\theta} c^{1-\theta},$$

where $\theta \neq 1$, or ln c, when $\theta = 1$ and θ is the risk aversion parameter. In the case of the option value model, $u(y) = y^{\gamma}$ plus a random error. There is no leading coefficient on γ, and the estimate of γ is 1.82. In the context of CRRA, $1 - \theta = 1.82$, so $\theta = -0.82$, a value outside the range for which CRRA utility is defined. Further, when $\gamma = 1.82$, the marginal utility of income is positive and increasing, not positive and decreasing.

[5] The estimate of this parameter in the option value model is 3.3, meaning that a dollar of retirement benefits is valued 3.3 times more than a dollar of earned income. The estimate in the Lumsdaine, Stock, and Wise dynamic programming model is about 1.5. The model, however, does not address the labor-leisure trade-off, so it is not clear how to interpret this result.

correlated, as would be expected if the error included individual taste and if taste remained the same from period to period. However, Ausink and Wise did not succeed in estimating the automatic correlation coefficient.

Several past studies have found a relationship between major airline hiring and the outflow of Air Force pilots. These studies all focus on pilot retention when the pilot is first at liberty to make a stay/leave decision, which is when the ADSC has been completed. The studies also include military pay relative to civilian pay, although the approaches differ, and the results can be used to infer the increase in military pay or ARP needed to offset an increase in hiring as it affects retention at the end of ADSC.

Elliott, Kapur, and Gresenz

Elliott, Kapur, and Gresenz (2004) found that major airline hiring, when lagged by one year, had a positive effect on the outflow of Air Force, Navy, and Marine Corps fixed-wing pilots at the end of ADSC. Their data cover entry cohorts from 1977 through 1989, a time when the Air Force ADSC was eight years after pilot training. Elliott, Kapur, and Gresenz did not have information on ADSC for individual pilots. Instead, they used a five-year range of years of service centered on when ADSC should end for a typical case and looked at retention within that range. Their regression estimates indicated that an increase in airline hiring of 1,000 would increase the outflow of Air Force pilots at the end of ADSC by 4.7 percentage points. In their data, airline hiring averaged 3,250 per year, so an increase of 1,000 was a 30-percent increase. The 4.7-percentage-point increase in outflow translates to an 8.2-percent decrease in retention relative to the average retention rate at ADSC of 57.6 percent. They estimated that a 50-percent increase in the present discounted value of ARP would counteract the outflow. For example, if the ARP contract were for a three-year service commitment and paid $25,000 annually (the statutory maximum), increasing the annual payment by 50 percent to $37,500 would approximately achieve the needed increase in present discounted value. Elliott, Kapur, and Gresenz also reported estimates for the Navy and Marine Corps and made hypothetical calculations for the Navy. The Navy estimates were not directly comparable to those of the Air Force because not all Navy pilots were eligible for ARP, and ARP was a major source of variation in military pay.[6] An increase in major airline hiring of 1,000 decreased the retention of Navy pilots at the end of ADSC by 1.7 percentage points, or 3.7 percent compared to an average retention rate of 46.7 percent. The Navy could offset this by an 18-percent increase in ARP, which amounted

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[6] Although Elliott, Kapur, and Gresenz created a civilian pay variable for pilots using pilot pay scales, they omitted this variable from their reported regression specification. Instead, they assumed that a pilot at the end of ADSC would either stay until reaching 20 years of service and then take an airline job or leave immediately and take an airline job, and in their regression they only included the military pay stream (stay until 20 years of service and then become a civilian pilot). They omitted the civilian pay measure because in their data most of the variation in expected civilian pay came from variation in the probability of being hired by a major airline, not from variation in salary. This may be a consequence of the way they created their civilian pay measure. They assumed that at the end of ADSC the probability of being hired by a major airline ranged from 20 percent, when hiring was at its minimum, to 85 percent, when hiring was at its maximum, and then linearly interpolated the probability between those points, depending on the level of hiring in other years. Pilots not hired by a major airline were assumed to be hired by a regional airline. After five years, 75 percent of those hired by a regional airline were assumed to switch to a major airline, and the remaining 25 percent were assumed to stay with a regional airline for the remainder of their career. Given the large difference between small and large airline salaries (covered in the next chapter), it is understandable that the probability of being hired by a major airline caused most of the variation in this measure of expected civilian pay. They took a similar approach to constructing civilian pay for pilots who left the military at 20 years of service but in this case assumed a much lower probability of being hired by a major airline, ranging from 5 percent to 30 percent.

to a $16,000 increase in its present discounted value. This increase would be on a lower base amount of ARP—the Navy's average ARP offer was less than half that of the Air Force—and would cost less than the Air Force's 50-percent increase.

Hansen and Moskowitz

Hansen and Moskowitz (2006) found that major airline hiring had a positive effect on Navy pilot departures at the end of ADSC. Their data covered retention decisions in the year of service in which ADSC ended from 1984 to 2005. They used the ACOL as their pay variable and estimated that a 1-percent increase in basic pay increased retention by 0.55 percent.[7] Their estimates implied that an increase of 1,000 major airline hires decreased the retention of jet and propeller pilots at ADSC by 2 to 3 percentage points (as compared to the 1.7 percentage point decrease found by Elliott, Kapur, and Gresenz). The average retention rate was 82 percent, so a 2-percentage-point change was a 2.4-percent decrease. Based on the ACOL coefficient, a $1,000-per-year increase in AP (then called aviation career continuation pay) decreased the outflow of pilots by 0.6 percentage points or, more specifically, decreased the outflow of jet pilots by 0.4 percentage points and of propeller pilots by 0.9 percentage points. Thus, an AP increase of roughly $5,000 a year for jet pilots and $2,300 a year for propeller pilots counteracted a 2-percentage-point increase in departures caused by the increase in airline hiring. Hansen and Moskowitz's model included year-fixed effects and the unemployment rate. The unemployment rate coefficient was statistically zero, suggesting that the year effects absorbed its variation. Hansen and Moskowitz also studied naval flight officers and did not find statistical evidence of a relationship between major airline hiring and departures. No cost estimates were provided.

Fullerton

Fullerton (2003) analyzed the retention of Air Force pilots at the end of ADSC for 1988 through 1999. ADSC was eight years of commissioned service at that time and has since increased to ten years. Fullerton's major airline hiring variable was the ratio of airline hiring in a year to the number of pilots in the Air Force pilot inventory in that year. A one-unit increase in the ratio decreased the probability of staying by 1.13 points when his regression was evaluated at the mean retention rate in his data of 48.5 percent, or by 2.3 percent. Fullerton's earnings variable was the lifetime earnings difference between staying in the Air Force to 20 years and then taking a job at a major airline versus leaving at the end of ADSC and taking a job at a major airline. A $100,000 increase in the difference led to a 1.92-point increase in the probability of staying. The results implied a trade-off between the hiring ratio and the earnings difference such that a one-unit increase in the ratio was offset by a $58,000 increase in Air Force career earnings (in 1999 dollars). The $58,000 can be contrasted with Elliott, Kapur, and Gresenz, who found that a $37,500 increase in the discounted present value of ARP was required. But Fullerton's lifetime earnings were apparently not discounted, so the quantities are not comparable.

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[7] Note that this refers to basic pay. As an approximation, basic pay is about 60 percent of officer compensation, so a 1-percent increase in basic pay is like a 0.6-percent increase in total pay, other things being equal. If so, the retention change is 0.92 percent (0.55/0.60) in response to a 1-percent increase in total pay.

Comments on the Studies

Elliott, Kapur, and Gresenz; Hansen and Moskowitz; and Fullerton all used airline pay scales in constructing their various measures of civilian compensation for military pilots. Elliott, Kapur, and Gresenz used pay scales from regional and major airlines and made assumptions about the probability of being hired by a major airline. Hansen and Moskowitz and Fullerton used major airline pay scales and some, though limited, information on career progression from first officer to captain and from smaller to larger aircraft. None of the studies considered civilian compensation for non-pilot positions. Also, pilot pay scales, which are stated in dollars per hour, are not the same as annual earnings, which depend on hourly pay and flying hours. Further, data on earnings by age for pilots show empirically how earnings increase with age rather than being based on assumed career progression. We used information on both airline pay scales and actual earnings to infer an age-earnings curve relevant to military pilots, as we discuss in the next chapter.

Our analysis complements Elliott, Kapur, and Gresenz; Hansen and Moskowitz; and Fullerton. They considered pilot retention at the end of ADSC, a major decision point for pilots. Elliott, Kapur, and Gresenz and Fullerton based military/civilian pay on the assumption that a pilot either would stay in the military until 20 years of service and then work for a major airline or, if leaving after ADSC, would find a spot with a major airline; Hansen and Moskowitz used pay scales and assumed career progression in constructing ACOL. The studies included a variable for major airline hiring, which was significant in all cases. As point-in-time analyses, the studies did not allow for dynamically optimal decisionmaking. The DRM (used by Gotz and McCall and in this study) allows tastes to differ among pilots and identifies the taste distribution. It allows for random shocks throughout military and civilian careers and models optimal decisionmaking under uncertainty. The DRM is forward-looking and can show how ARP influences retention both before and after the decision point. The "before the decision point" case is relevant when a pilot signs an ARP contract in the years of service after ADSC ends. Also, the model treats entire careers and shows retention behavior in all years. The model handles multi-year commitments tied to ARP in a formal way that allows a pilot to choose the length of commitment optimally. The DRM uses major airline hiring at the time the pilot reaches the end of ADSC; Hansen and Moskowitz also used major airline hiring, while Elliott, Kapur, and Gresenz and Fullerton used all airline hiring. We used the estimated DRM to simulate the impact on pilot career retention of alternative levels of airline hiring and pay increase and to determine the level of ARP needed to offset the impact.

A Forecast Pilot Shortage

Duggar, Smith, and Harrison (2009) reasoned that the excellent safety record of U.S. carriers created a global demand for commercial pilots trained to the practical test standards of the Federal Aviation Administration (FAA). In addition, U.S. carriers can be expected to add planes to their fleet. These conditions generate the potential for a shortfall of certified U.S. airline transport pilots (ATP).

To quantify the possible shortfall, Duggar, Smith, and Harrison began with an FAA forecast (FAA, 2009) of the ATP pilots and the U.S. carrier jet aircraft fleet. FAA predicted annual average growth rates of 0.35 percent for ATP pilots and 2.9 percent for U.S. carrier jet aircraft. Using the FAA forecast, Duggar, Smith, and Harrison assumed that the fraction

of ATP pilots employed by U.S. carriers would be constant at its 2009 level of 0.5156. The number of pilots at those carriers was then forecast by multiplying the total number of ATP pilots by 0.5156. To forecast the demand for additional pilots, Duggar, Smith, and Harrison first computed the ratio of ATP pilots employed by U.S. carriers in 2009 to their jet aircraft fleet in 2009, which was 22.62 (76,134/3,365) and then multiplied this number by the FAA forecast of the U.S. carrier jet fleet. This approach produced a shortfall of more than 25,000 pilots by 2020 (Table 2.1). Duggar, Smith, and Harrison used the shortfall to argue that flight training programs needed to be made less expensive through the use of technology, such as flight simulators, and regional airlines may need to fund investment in this technology to expand the capacity to train new pilots.

The study's fixed coefficients are challengeable. Carriers could expand and attract a higher fraction of pilots than 0.5156. The pilot-to-plane ratio of 22.62, more generally, depends on the number of crews needed to serve a carrier's jet fleet, which depends on its flight schedule, network, and pilot use/rest regulations. Changes that result in more flying time per pilot per month could reduce this ratio, such as longer stages and less down time between flights. The assumption that the U.S. carrier jet fleet will grow at 2.9 percent a year is at odds with a Boeing (2014) forecast of 1.6 percent annual growth in the North American airline fleet. This is a major difference, and it alone decreases the shortfall from 25,150 to 11,642.

Chapter Three discusses pilot supply and compensation. In Chapter Four, we take a different approach toward gauging the demand for pilots and focus on major airlines. This analysis relies on the projected number of pilot retirements and the growth in the demand for air transport.

Table 2.1
Alternative Forecasts of a U.S. Pilot Shortage

		Duggar, Smith, and Harrison (2009)				Alternative Based on Boeing (2014) Growth Forecast		
Year	ATP Forecast (FAA)	Forecast U.S. Carrier Pilots	U.S. Carrier Jet Aircraft (FAA)	Forecast Demand for U.S. ATP Pilots	Shortfall of U.S. ATP Pilots	U.S. Carrier Jet Aircraft (Boeing)	Forecast Demand for U.S. ATP Pilots	Shortfall of U.S. ATP Pilots
2009	147,650	76,134	3,365	76,134	0	3,365	76,134	0
2010	148,400	76,520	3,587	81,157	4,637	3,419	77,352	832
2011	149,100	76,881	3,716	84,075	7,194	3,474	78,590	1,709
2012	149,700	77,191	3,823	86,496	9,305	3,529	79,847	2,656
2013	150,300	77,500	3,870	87,560	10,060	3,586	81,125	3,625
2014	150,850	77,783	3,953	89,438	11,655	3,643	82,423	4,640
2015	151,350	78,042	4,043	91,474	13,432	3,701	83,742	5,700
2016	151,800	78,274	4,131	93,465	15,191	3,760	85,081	6,807
2017	152,250	78,506	4,229	95,682	17,176	3,821	86,443	7,937
2018	152,700	78,738	4,390	99,325	20,587	3,882	87,826	9,088
2019	153,150	78,970	4,501	101,836	22,866	3,944	89,231	10,261
2020	153,600	79,017	4,604	104,167	25,150	4,007	90,659	11,642

CHAPTER THREE

Sources of Pilot Supply

Sources of pilot supply to major airlines differ in the paths and time lines for supplying qualified pilots that meet FAA rules and regulations. Sources of pilots include the following:

- civilian flight schools
- ATP certificate holders not working for an airline
- furloughed pilots
- smaller airlines
- military pilots.

Our dividing line between major and non-major airlines is empirical: A major airline is one that flies 737 and A300 series or larger aircraft. This would include, for instance, the Boeing 737 and Airbus 320, which are classified as small narrow-body aircraft. This is a useful dividing line because pay scales are distinctly higher at airlines flying 737/A300 and larger aircraft, as we show. Airlines flying larger aircraft also have more aircraft and pilots. Under this approach, the major airlines are Southwest, Delta, United, Alaska, Hawaiian, JetBlue, American, Virgin America, and Spirit. The small airlines are Horizon, Compass, AirWisconsin, GoJet, PSA, Endeavor, TransStates, Mesa, and CommutAir.

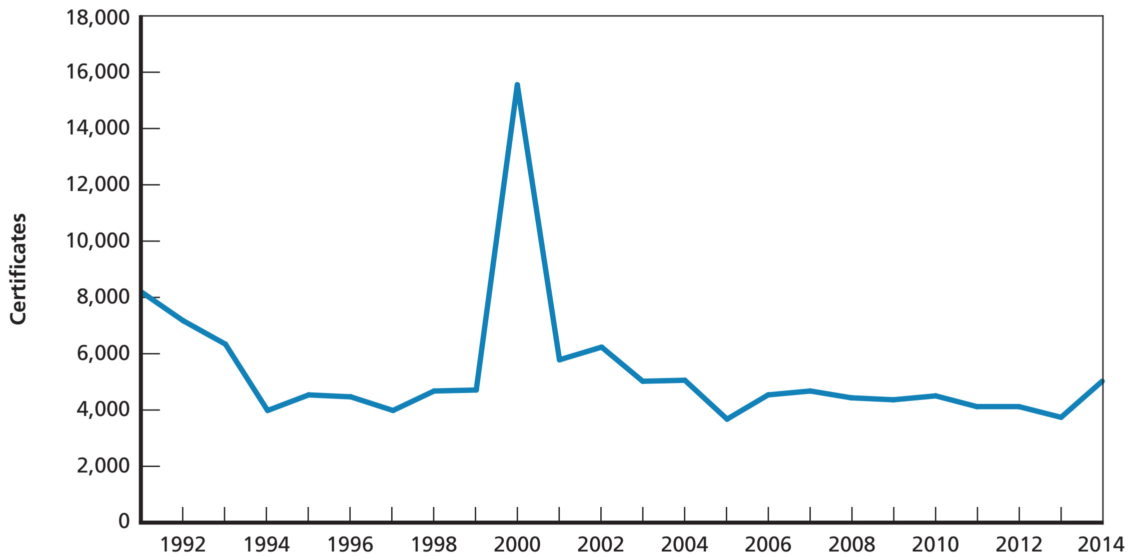
We used data from the Department of Transportation, the FAA, the Bureau of Labor Statistics, the American Community Survey (ACS), Airline Pilot Central, and Future & Active Pilot Advisors (FAPA). We benefited from the Massachusetts Institute of Technology (MIT) Airline Data Project, which compiled data from federal sources.

Civilian Flight Schools

One path for preparing pilots is through FAA-certified civilian flight schools at two- or four-year colleges. Students typically graduate from these schools with a commercial pilot certificate. Afterward, they often accumulate flight time as a certified flight instructor (CFI) and then certify as an ATP, which is required to fly for an airline (GAO, 2014). New pilots usually graduate with 250 flying hours and take one to two years to reach the number of hours needed to qualify for an ATP certificate (GAO, 2014). FAA rules require pilots or first officers to have a minimum of 1,500 hours of flying experience for the ATP, while restricted ATP (R-ATP) rules specify a minimum of 750 hours of total pilot time for military pilots.

From the perspective of eventual airline pilots, the number of newly issued CFI certificates is a relevant measure (Figure 3.1). According to sources cited in Higgins et al. (2013),

Figure 3.1
Original Certified Flight Instructor Certificates, 1991–2014



SOURCE: FAA, 2015.
RAND *RR1455-3.1*

which uses this measure, 54 percent of CFI certificate holders plan to work at the airlines, and 85 percent of civilian-trained ATP pilots hired by the airlines held a CFI certificate. The number of original certificates has averaged about 4,000 a year over the past ten years, apart from the anomaly in 2000.

Another measure is the number of original ATP certificates issued (Figure 3.2). This includes graduates of flight instruction programs who go on to accumulate the requisite number of flying hours to qualify for an ATP certificate. It can take several years to reach 1,500 flying hours. The number of originally issued ATP certificates grew from 3,072 in 2010 to 7,749 in 2014. Originally issued ATP certificates also include individuals who qualify via CFI and by other routes, such as by accumulating flying hours without serving as a flight instructor. This latter group would include, but would not be limited to, pilots who had trained in the military, separated, and sought an ATP certificate.

ATP Certificate Holders Not Working for an Airline

Individuals with an active ATP certificate who are not employed in the airline industry are another possible source of pilots. To estimate the number of this group, we looked at the difference between the number of ATP certificate holders and the number of pilots employed by the airlines. In 2014, there were more than 140,000 active ATP certificates[1,2] (Figure 3.3). We have

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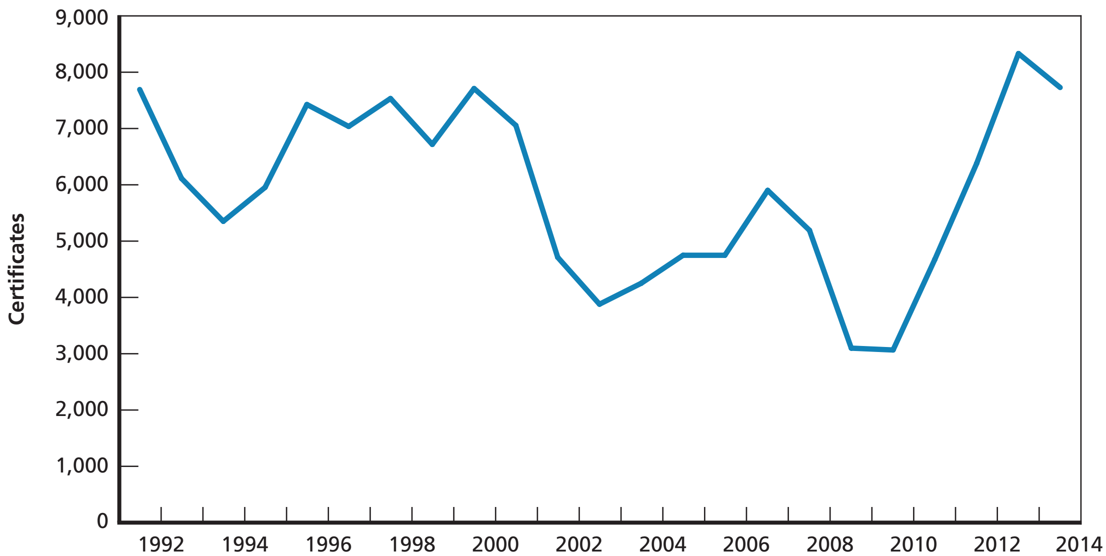
1 Available at FAA, 2015.

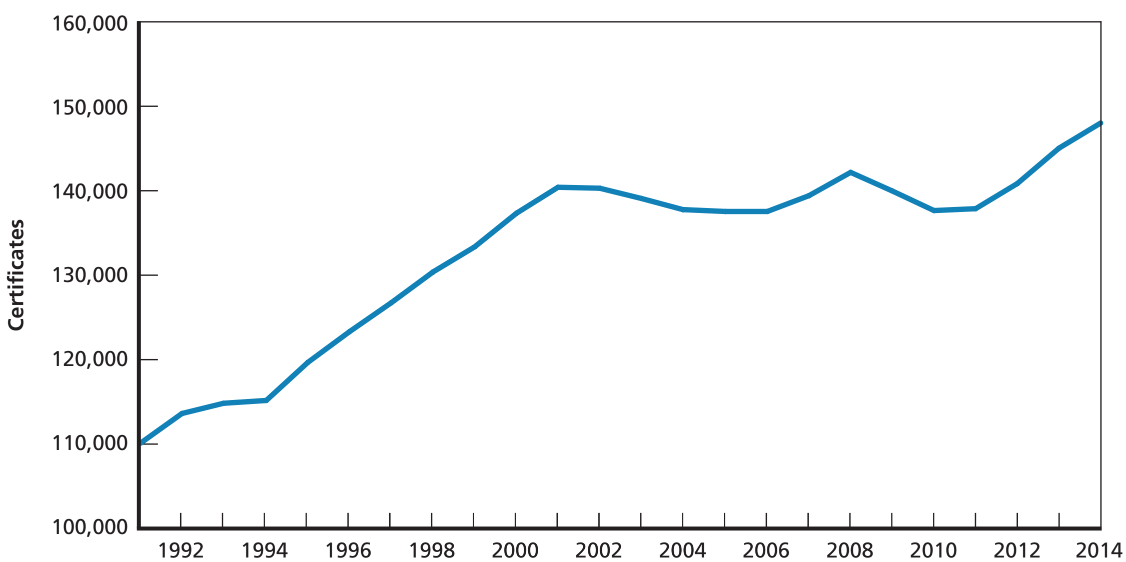
2 Another possible source would be inactive ATP certificate holders who complete a flight review, obtain a medical certificate, and become active. The holder of an ATP certificate must pass a flight review every 24 months in order to remain qualified to fly the aircraft for which the pilot is rated (U.S. Government Publishing Office, 2016).

Figure 3.2
Originally Issued Airline Transport Pilot Certificates, 1991–2014



SOURCE: FAA, 2015.
RAND *RR1455-3.2*

Figure 3.3
Number of Active Airline Transport Pilot Certificates, 1991–2014



SOURCE: FAA, 2016.
RAND *RR1455-3.3*

two figures for the number of pilots employed by the airlines: There were 75,786 employed pilots in 2014, according to Airline Pilot Central (Table 3.1).[3] According to the Occupational Employment Statistics (OES) survey, 75,760 people were employed as airline pilots, co-pilots, and flight engineers in 2014 (Table 3.2). Approximately 50,000 pilots are employed by major airlines, and the remainder are at small airlines. Overall, about 65,000 ATP certificate holders were not working for the airlines. Many of these, 38,170, were commercial pilots, according to the OES survey.

CFI and ATP certificate holders are potential sources of pilot supply to the airlines. As mentioned, only about half of the CFIs plan to enter aviation as a career. One analysis, Higgins et al. (2013), found that the number of new CFIs was positively related to large airline hiring and negatively related to the cost of flight instruction and that the positive impact of large airline hiring decreased as the cost of flight instruction increased. The analysis was based on 19 observations, and so we caution against regarding the findings as robust, despite the statistical significance of the coefficients. We have not found analyses of transition from non-airline to airline positions among ATP holders not currently working at an airline.

Furloughed Pilots

Many pilots were furloughed in the aftermath of the September 11, 2001, terrorist attacks and the subsequent downturn in the airline industry. But the airlines have recovered since then, and personal communications with United, Delta, and American, as well as information posted on Airline Pilot Central (Airline Pilot Central, 2016), indicate that the large airlines have recalled, or offered to recall, all of their furloughed pilots.

Small Airlines

Pilots at small airlines are already self-selected in wanting to fly for an airline, whereas pilots with CFI or ATP certificates but not employed by an airline may be less inclined to do so. The pay at large airlines is a strong incentive for new pilots to "pay their dues" by working at a small airline as a stepping stone to a major airline. In fact, the major airlines do not have a shortage of applicants. A Delta spokesman told us its queue of qualified applicants had about 4,000 pilots, though the same individuals often apply to all of the major airlines.[4] When American Airlines announced in 2014 that it would hire 1,500 pilots over the next five years to replace retiring pilots, it received 10,000 applications in six weeks (Carey and Nicas, 2014). The large number of applicants suggests that major airline pay scales are above the market clearing level, and, by implication, pay would not have to be increased to meet an increase in hiring goals. The pay rates may reflect the bargaining strength of the pilot union.

Major airlines rely on small airlines to provide travelers with air service beyond the majors' routes, which increases their capacity and revenue (GAO, 2014). If major airlines hired too many pilots from small airlines, small airlines' service could be impaired, and this could affect the major airlines. Also, smaller locations would not want to see their air service diminish.

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[3] In preparing this table, we excluded a few airlines that service the Caribbean islands.

[4] Conversation with the authors during a Project AIR FORCE roundtable on Air Force pilot retention, August 2014.

Table 3.1
Pilot Employment by Airline, 2014

Airline	Number of Pilots
United	12,505
Delta	11,723
American	11,357
Southwest	6,830
Express Jet	4,633
US Airways	4,465
SkyWest	3,375
Republic	3,000
JetBlue	3,000
American Eagle	2,650
Endeavor	1,722
AirTran	1,526
Alaska	1,472
Spirit	1,043
AirWisconsin	860
PSA	860
Mesa	855
Hawaiian	627
Virgin	618
Horizon	585
Allegiant	515
GoJet	510
Compass	439
TransStates	370
SunCountry	246
Total	75,786

SOURCE: Airline Pilot Central, 2016.

Table 3.2
Employment of Airline Pilots, Co-Pilots, and Flight Engineers, 2001–2014

Year	Number Employed
2001	88,800
2002	78,810
2003	79,770
2004	78,490
2005	76,240
2006	75,810
2007	78,250
2008	77,090
2009	74,420
2010	68,580
2011	68,350
2012	66,270
2013	73,030
2014	75,760

SOURCE: BLS, 2016.

According to Higgins et al. (2013), regional airlines serve 681 airports across the country, and about 70 percent of these are served only by regional airlines.

Military Pilots

Military pilots must meet FAA requirements in terms of flying hours, training and, if they are to be hired by a large airline, certification to fly 737/A300-type aircraft or larger. Military flying hours are credited toward the FAA hours requirement, and military pilots usually have enough hours to qualify for an ATP certificate by the time they separate. FAA regulations permit former military pilots with 750 hours of total time as a pilot to obtain restricted certification (R-ATP), allowing them to serve as first officers until they reach the 1,500 hours of flying time needed for a regular ATP certificate. FAA regulations are stricter for pilots who graduate from two- and four-year colleges: They require 1,000 and 1,250 hours of flying time, respectively, for an R-ATP. Military pilots compete with other pilots in a major airline's applicant pool.[5] A former military pilot with 11 years of service might have 2,000 hours of flying time, for example, while a pilot from a small airline might have 4,000 hours.

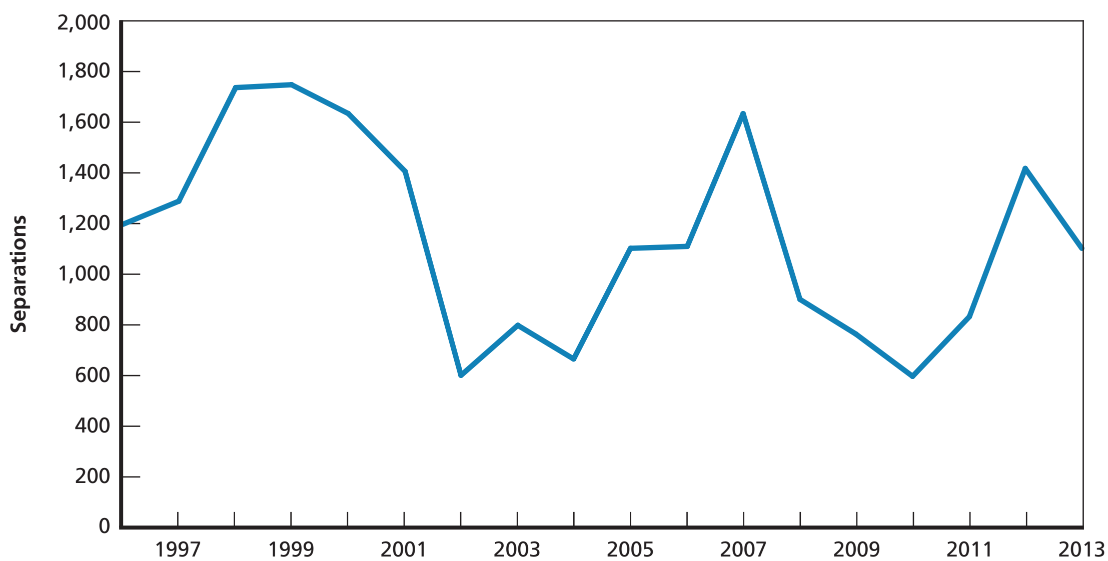
[5] Some airlines credit former military pilots with additional hours based on their military activities. For example, fighter pilots may be credited with additional hours based on the number of sorties flown, in recognition of the fact that while sorties may be short, they still involve the key aspects of flying: taking off, flying a specified route, and landing.

We show below that the monetary incentive for a military pilot to become a civilian pilot at a major airline is greatest when the pilot is first eligible to leave—currently, this is after ten years of commissioned service.

The number of pilots separating from the regular Air Force from 1996 to 2013 ranged from 600 to 1,800 per year (Figure 3.4) and averaged just over 1,400 a year, or about 11 percent of the Air Force pilot inventory of approximately 13,000. If all separating pilots obtained an ATP certificate in their year of separation, they would total 13 to 28 percent of the number of originally issued ATP certificates over these years (Figure 3.2). The cost of obtaining an ATP certificate is likely to be lower for military pilots flying large multi-engine aircraft, as they need little post-service training to be rated for such aircraft. In contrast, rotary-aircraft pilots would require more training.[6]

Chapter Five discusses major airline demand for pilots, but we include a chart on major airline hiring here for comparison with Air Force pilot separations. The hiring data are from FAPA. Figure 3.5 shows hiring at United, American, Southwest, Delta, FedEx, JetBlue, Continental, Northwest, UPS, AirTran, US Airways, America West, and Alaska. Hiring increased during the 1990s, dropped sharply after 2000, recovered in the mid-2000s, dropped again during the Great Recession of 2007–2009, and rose sharply from 1,084 in 2013 to 3,053 in 2014.

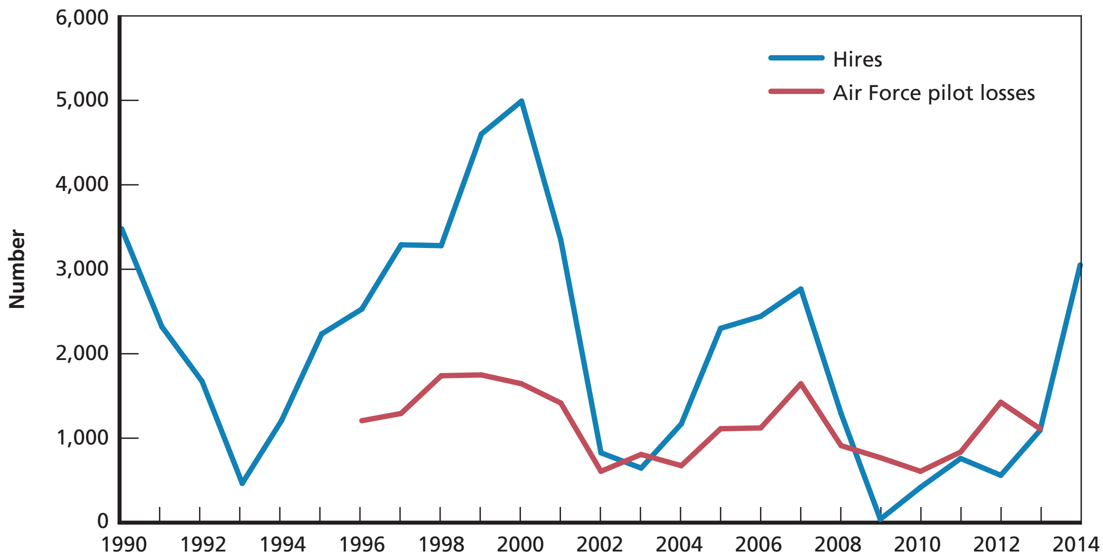
Figure 3.4
Regular Air Force Pilot Separations, 1996–2013



SOURCE: McGee, 2015.
RAND *RR1455-3.4*

6 For a more precise look into the transition from the military to a civilian airline, it would be helpful to have longitudinal data on a pilot's military career, including training and experience by type of aircraft, and on subsequent civilian experience, such as ATP certification, job applications to airlines or non-airline positions, hiring, tenure, and salary. Another approach would be to survey veterans who were pilots in the military, asking about their civilian employment (pilot, other), earnings, and military career.

Figure 3.5
Major Airline Pilot Hiring, 1990–2014, and Regular Air Force Pilot Separations, 1996–2013



SOURCE: FAPA, undated; McGee, 2015.
RAND *RR1455-3.5*

Figure 3.5 indicates that Air Force pilot separations tend to move in tandem with major airline hiring. The correlation between these series is 0.81. This finding, as along with the results of past studies, underscores the importance of controlling for major airline hiring in the DRM (see Chapter Five).

Civilian Airlines' Seniority System

A pilot's work schedule, speed of advancement, and pay depend on seniority (GAO, 2014). New pilot hires start at the bottom rung as first officers and must gain seniority before they are assigned their preferred routes and schedules (e.g., schedules that do not require them to fly on weekends and holidays). After serving as a first officer and being promoted to captain, pilots start at the bottom of the career ladder for captains and gradually (e.g., over six years or so, according to the GAO report [2014]) reach a senior level at which their routes and scheduling preferences receive priority. In some cases, a first officer turns down the promotion to captain because of the disincentive of losing priority over schedules and routes. Compared with other careers, pilots are constrained in terms of their career progression. A pilot wanting to move to another airline would have to start at its entry level. This represents a high cost of moving between airlines, and the implication is that a major airline is unlikely to be able to increase its pilot workforce by attracting pilots from other major airlines.

CHAPTER FOUR

Pilot Pay

We examined several sources of information about pilot pay. These include average annual salary data from the U.S. Department of Transportation (DOT), airline pay scales for major airlines, pay increases at major airlines called for under contracts with the pilot union, and ACS data on pilot earnings. The average annual salary data show a large decrease after 2005 and a nearly full recovery by 2014. In particular, the large salary increase from 2013 to 2014 occurred at the same time as the large increase in major airline hiring described in the previous chapter. The airline pay scales show that pay rates differ by the type of large aircraft, rank (first officer, captain), and years in rank. We used pay scales for 2014 to show the hourly rates prevailing at that time and to provide a foundation for describing how a pilot might rise up the pay scales over a career. This specific information on pay rates also provides a reference point for determining the pilot annual earnings percentile corresponding to earnings at major airlines. We used ACS data to estimate regressions (shown in Appendix A) on pilot annual earnings, which we then used to predict earnings by age and earnings percentile. Annual earnings data are important because, unlike the airlines' pay scales, which are in dollars per hour, the annual earnings data depend on hours worked (reimbursed hours) as well as the hourly rate. Based on the pay scales, the 80th percentile of pilot earnings for military veterans approximates what a military pilot could be expected to earn at major airlines. We also predicted annual earnings for non-pilots. This is relevant because non-pilot and pilot jobs are both relevant alternatives for military pilots. Finally, we used the union contracts to project the increase in pay at United, American, and Delta from 2014 to 2018. The pilot and non-pilot age-earnings curves are included as input to the DRM, and the percentage increase in pilot pay helped us in structuring scenarios of how increases in major airline pay and hiring could affect Air Force pilot retention.

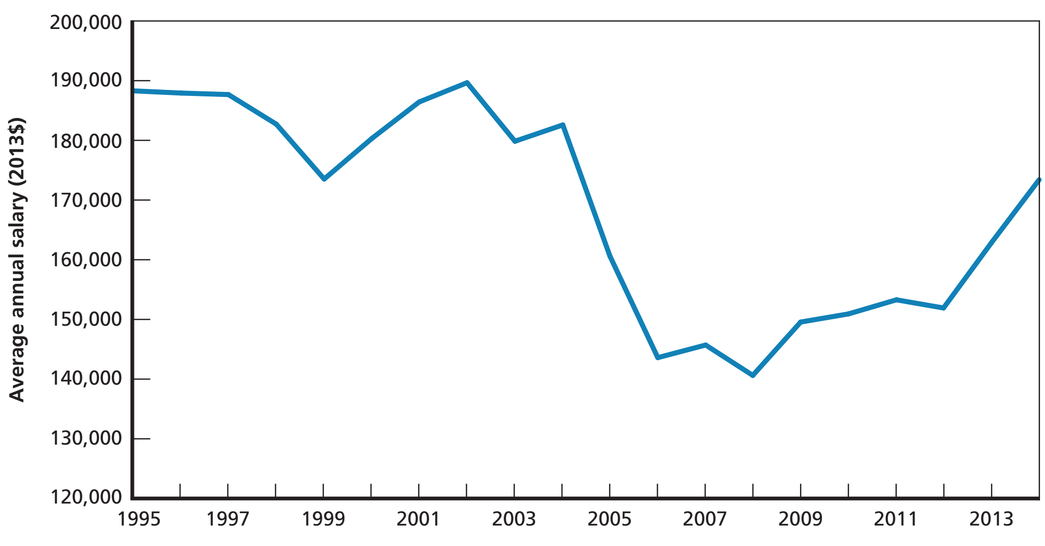
In addition, we compared the present discounted value of civilian earnings for pilots and non-pilots from the perspective of military pilots of different ages. This comparison shows that the monetary gain from leaving the military to work as a pilot rather than at a non-pilot job decreases with age. The monetary gain from leaving is greatest at a relatively young age—e.g., when the pilot has completed ADSC. These present discounted value calculations do not account for individual preferences for military service, uncertainty, or the willingness to accept a multi-year commitment under ARP, which are taken into account in the DRM, but they serve the purpose of crudely indicating the size of the monetary incentive. We have placed this comparison in Appendix B.

Average Annual Salary of Pilots and Co-Pilots

DOT provides annual data by airline on pilot salaries for first officers ("co-pilots") and captains. DOT computes average annual salary as the ratio of total salary expenditures to the number of pilot and co-pilot equivalents. Figure 4.1 shows average annual salary weighted by pilot and co-pilot employee equivalents and adjusted for inflation to 2013 dollars, for 1995 through 2014, the most recent annual data available. The airlines include American, Continental, Delta, Northwest (which has since merged with Delta), United, US Airways (which has since merged with American), American West (which has since merged with US Airways), Southwest, JetBlue, AirTran, Frontier, and Virgin America.[1] From 1995 to 2004, average salary was usually \$180,000 to \$190,000, but it was less than \$160,000 from 2006 to 2012. From 2012 to 2014, it rose from \$151,939 to \$173,344.

Bankruptcies, mergers, and recessions between 1990 and 2013 affected average salary. For instance, rapid hiring in the late 1990s led to a decrease in average salary, while furloughs in the early 2000s increased it. The salary decrease after 2004 may reflect bankruptcy and reorganization that led to lower pay scales. The decrease is paralleled in the year effects in the pilot earnings regressions reported in Appendix A. In particular, the year effects show pilot earnings about 8 percent lower from 2005 through 2011 than from 2002 through 2004. Relating this to Figure 4.1, we found that the average from 1995 through 2004 was roughly \$185,000, and if we take \$150,000 as an estimate of the average salary from 2005 through 2012, the decrease is 19 percent. The regression, however, indicates a decrease of about 8 percent. The regression

Figure 4.1
Average Annual Salary of Pilots and Co-Pilots at Major Airlines, 1995–2014 (in 2013 dollars)



SOURCES: DOT Form 41 via Bureau of Transportation Statistics (BTS), Schedules P6 and P10, MIT Airline Data Project.
NOTE: Deflated with the CPI-U.
RAND *RR1455-4.1*

[1] A limitation of this measure of pilot salary is that it can be affected by changes in the tenure mix of pilots. During periods of furloughs or little hiring, an airline's pilot workforce becomes more senior, and average salary tends to increase. In periods of expansion, the reverse happens, as junior pilots join the workforce and average salary decreases.

data include all pilots, though, while Figure 4.2 is for major airlines. The comparison suggests that pilot salary fell by nearly twice as much at major airlines as for pilots overall. Also notable is the fact that the average salary had increased to $173,000 in 2014, which was 6.5 percent below $185,000.

2014 Pay Schedules at Major Airlines

The Airline Pilot Central website provides pay scales for commercial airlines. Pay at an airline varies by rank (captain, first officer), seniority (number of years in rank), and type of aircraft. The columns in Table 4.1 show hourly pay rates for each of three types of aircraft flown by these airlines: wide-body aircraft (e.g., A380, 747, 777-200/300, 767-400, A330, 787, A350), large narrow-body aircraft (e.g., 767-200, B757-200, B767-300), and small narrow-body (e.g., A319, A320, A321, MD80, B737). For each airline, we have taken a simple average of hourly rates across the different aircraft within each of the three broad categories of aircraft. Pay rates are similar within category, so the simple average is reasonable. Because of their merger, American and US Airways have the same pay scale. Also, United merged with Continental, and, although United and Delta are separate airlines, they currently have the same pay scales. Therefore, the table lists the rates for American/US Airways and for United/Delta.

Hourly pay is much higher for wide-body aircraft than for large narrow-body and small narrow-body aircraft. A newly hired pilot would typically be a first officer on a narrow-body aircraft. First-year pay for a first officer was $39 to $66 an hour, depending on airline and type of plane, but jumped to about $82 to $149 in the second year. American/US Airways had the lowest pay scale for wide-body aircraft—but, as explained in the next section, this disparity will be eliminated in 2016. At 12 years of experience, which is at or near the top of the pay scale for these airlines, first officer pay was $158 to $174 an hour, and the starting rate for captains was $158 to $233 an hour. FAA limits flight time to a maximum of 1,000 hours a year, and at maximum hours, first officer earnings range from $83,000 (excluding the first year) to $186,000, and captain earnings range from $158,000 to $262,000.

The pay scales in Table 4.1 are the highest among the airlines. Pay is comparatively low for first officers at small airlines, starting at $20 to $30 an hour and not exceeding $50 an hour at the top of the scale, which is often reached within eight years. The transition to captain at these airlines can bring an immediate increase on the order of $20 an hour. Captain scales start at $50 to $70 an hour and increase to $80 to $95 an hour at 12 years.

To offer an example illustrating upward mobility from small airlines to large-jet airlines, a 23-year old ATP pilot might spend four years as a first officer at a small airline and be promoted to captain, with pay rising from $40 to $60 an hour. After eight years as a captain, the pilot, now age 35, would have a wage of $75 an hour. If the pilot were then hired as a first officer by a large airline, he or she would earn $50 an hour in the first year but $75 an hour the second year. If after ten years the pilot, now age 45, were promoted to captain, his or her pay would increase from $125 an hour to $165 an hour. A captain's pay can rise well above $200 an hour as the captain transitions from small narrow-body to large narrow-body and then to wide-body aircraft.

Table 4.1
Hourly Pay Rates for Selected Airlines, 2014

		Wide-Body				Large Narrow-Body				Small Narrow-Body			
Rank	Tenure	American/ US Airways	United/ Delta	UPS	FedEx	American/ US Airways	United/ Delta	UPS	FedEx	American/ US Airways	United/ Delta	UPS	FedEx
Captain	15	N/A	N/A	262	261	N/A	N/A	262	225	N/A	N/A	N/A	225
	14	N/A	N/A	259	258	N/A	N/A	259	222	N/A	N/A	N/A	222
	13	N/A	N/A	257	255	N/A	N/A	257	220	N/A	N/A	N/A	220
	12	233	255	255	254	195	213	255	218	181	205	N/A	218
	11	231	253	252	251	193	210	252	215	179	201	N/A	215
	10	229	251	249	248	192	208	249	213	178	199	N/A	213
	9	227	250	246	245	190	206	246	210	177	198	N/A	210
	8	226	247	245	244	189	204	245	209	175	196	N/A	209
	7	224	245	244	243	187	203	244	208	174	195	N/A	208
	6	222	243	243	242	186	201	243	207	172	193	N/A	207
	5	220	241	242	241	184	200	242	206	171	192	N/A	206
	4	219	240	241	240	183	199	241	205	170	190	N/A	205
	3	217	238	240	239	182	196	240	203	168	189	N/A	203
	2	215	235	240	239	180	195	240	202	167	187	N/A	202
	1	193	233	225	215	167	193	225	182	158	186	N/A	182
First officer	15	N/A	N/A	186	185	N/A	N/A	186	163	N/A	N/A	N/A	163
	14	N/A	N/A	184	185	N/A	N/A	184	162	N/A	N/A	N/A	162
	13	N/A	N/A	183	182	N/A	N/A	183	161	N/A	N/A	N/A	161
	12	158	174	182	182	132	145	182	160	123	140	N/A	160
	11	157	173	177	177	131	143	177	155	122	139	N/A	155
	10	154	170	172	172	129	142	172	149	120	138	N/A	149
	9	151	168	168	167	126	139	168	144	117	136	N/A	144
	8	147	167	165	164	123	138	165	141	114	135	N/A	141
	7	143	163	161	161	120	135	161	138	111	131	N/A	138
	6	140	158	158	157	117	131	158	135	108	128	N/A	135
	5	137	155	155	154	114	128	155	132	106	125	N/A	132
	4	133	151	152	151	111	125	152	129	103	122	N/A	129
	3	130	148	149	148	109	122	149	126	101	118	N/A	126
	2	107	126	149	148	90	104	149	121	83	102	N/A	121
	1	40	66	39	65	40	66	39	63	40	66	N/A	63

SOURCE: Airline Pilot Central, 2016.

NOTE: N/A = not applicable.

A Projected Increase in Pilot Hourly Pay

We first describe pay increases at American, Delta, and United. These airlines accounted for 70 percent of the pilots and first officers employed at major passenger carriers. Based on contracts with the pilots union, pilot pay scales at these airlines will increase, on average, by 29 percent from 2014 to 2018. For comparison, this is much faster than the recent increase in the employment cost index for private professional, managerial, and related occupations, which grew by 3 percent from 2010 to 2015.[2]

American

American Airlines pilots, as a precursor to the merger with US Airways, approved in December 2012 a six-year contract that increased pay by 4 percent on signing and 2 percent a year after that, with an adjustment in the third year to bring pay in line with that at other major airlines.[3] The collective bargaining agreement called for American/US Airways pilots to reach pay parity with Delta and United pilots in 2016.[4] American Airlines pilots accepted a new contract in January 2015, raising hourly wages by 23 percent retroactive to pay on December 2, 2014, 3 percent with respect to original pay on January 1, 2015 (i.e., pay in January 2015 was 26 percent above pay as of December 2, 2014), and another 3 percent in 2016.[5]

Delta

Delta pilots' contract increased pay by 4 percent in 2012, 8.5 percent in 2013, and 3 percent in 2014 and 2015.[6] Delta's latest contract, authorized in the summer of 2015, gave pilots an 8-percent raise on July 1, 2015, and a 6-percent raise on January 1, 2016. It also provides 3-percent hourly pay rate increases in January 2017 and 2018.[7]

United

United/Continental pilots ratified a labor agreement in December 2012 providing an 8.5-percent raise in January 2014 and 3-percent raises in 2015, 2016, and 2017.[8] In early 2016, United/Continental pilots approved an extension of the 2012 labor agreement, which included a 3-percent raise on January 1, 2016, followed by a 13-percent increase in pay at the end of January 2016 and increments of 3 and 2 percent over the next two years.[9]

Figures 4.2 and 4.3 illustrate these increases. Figure 4.2 plots the percentage increase in hourly pay from January 2014 to December 2018 by airline. The figure also shows the average increase, where the average uses airline pilot employment in 2014 as the base weight. The increase from 2014 to 2018 is 29 percent. Figure 4.3 shows how the increases affect the pay

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2 BLS, 2014b.

3 Koenig, 2012.

4 FAPA, 2014.

5 Dastin and Ajmera, 2015.

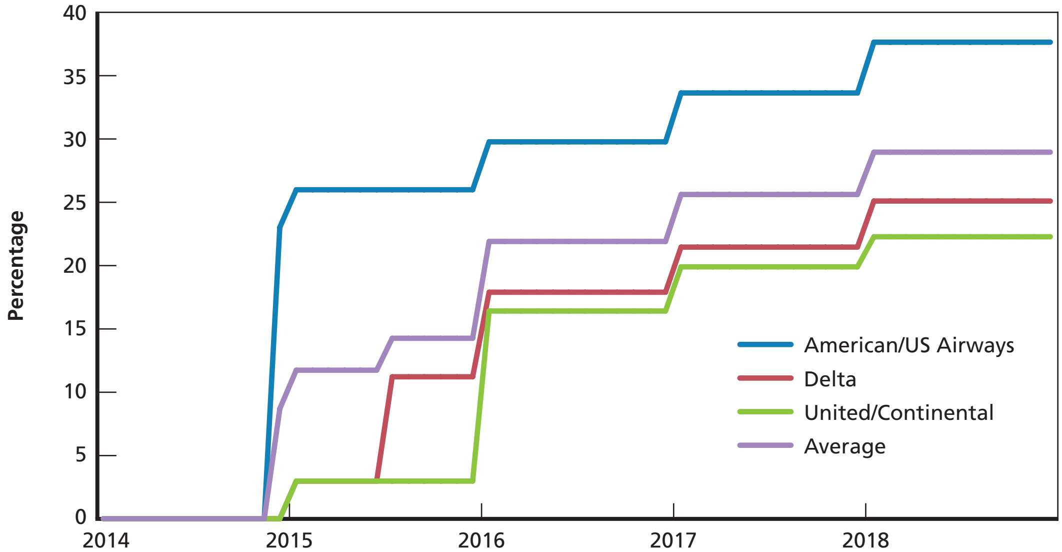
6 Yamanouchi, 2012; Maxon, 2012.

7 Carey, 2015; Dastin and Jaisinghani, 2015.

8 Carey, 2012.

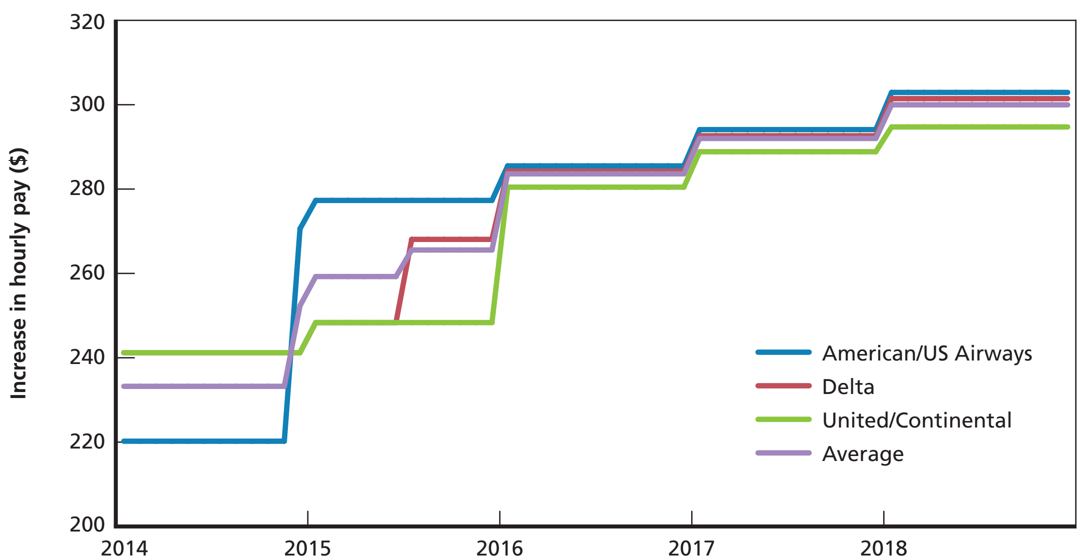
9 Channick, 2016.

Figure 4.2
Percentage Increase in Hourly Pay at American, Delta, and United, 2014–2018



SOURCE: Authors' calculations.
RAND *RR1455-4.2*

Figure 4.3
Increase in Hourly Pay at American, Delta, and United for a Captain with Five Years of Seniority, 2014–2018



SOURCE: Authors' calculations.
RAND *RR1455-4.3*

of a captain with five years of seniority. This figure confirms that the 2015 American Airlines contract brings its pilot pay to par with Delta and United.

Other Airlines

Pay rates are increasing at other airlines, although not by as much as at American, Delta, and United. In 2010, Spirit Airlines approved a five-year contract augmenting captains' salary by 10 percent and first officers' salary by 18 percent, which also included a signing bonus.[10] Virgin America pilot salaries rose in 2015, with hourly wages augmented by 15 percent.[11] In 2010, Southwest Airlines pilots ratified a contract raising pay by 3 percent.[12] Alaska Airlines pilots came to an agreement in 2013 to increase hourly wages by 20 percent over the course of the next five years.[13] The pilots at Horizon Air, a subsidiary of Alaska Air Group, ratified a contract in 2016 that is expected to raise pilot pay, though the official percentage has not yet been released.[14] JetBlue pilots' 2014 labor agreement provided a 20-percent increase in the base rate of pay by 2017.[15] In 2015, FedEx pilots approved a contract with a signing bonus and with increases in hourly wages of 10 percent initially and then by slightly over 3 percent each year through 2021.[16]

Overall Pay Scale Increase

These increases cannot be easily summarized by an overall percentage. The Alaska, Jet Blue, and FedEx increases are on the order of 20 percent by 2017, while the other airlines plan smaller increases. If the average increase among these airlines were 20 percent from 2014 to 2018, the overall average increase would be 26.3 percent ($0.7 \times 29 + 0.3 \times 20$). If their increase were 15 percent, the overall average increase would be 24.8 percent. We assume a 25-percent increase.

Inflation will decrease the value of these nominal wage increases. The CPI-U rose by 0.76 percent and 0.73 percent in the 12-month periods ending in December 2014 and December 2015, respectively, and the Congressional Budget Office projects inflation of 2 percent for the next few years.[17] These percentages amount to 7.7 percent inflation from 2014 to 2018, so the inflation-adjusted increase in pilot pay would be about 17 percent (25 – 8).

The DRM also includes non-pilot pay, and the increase in pilot pay should be judged relative to it. The employment cost index for private industry management, professional, and related workers grew by 3 percent over the five-year period from 2010 to 2015.[18] There was literally no change in this cost index from 2010 to 2013 as the economy recovered from the recession, and the increase from 2013 to 2015 was 3 percent, or an average of 1.5 percent per year.

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10 Giovis, 2010.

11 Steiner, 2015.

12 Hall, 2010; Panchuk, 2010.

13 Spain, 2013.

14 Alaska Air Group, 2016.

15 Bloomberg News, 2014.

16 Risher, 2015.

17 Congressional Budget Office, 2016.

18 BLS, 2014b.

At the latter rate of increase, non-pilot pay would increase by 7.7 percent (1.5 × 5) from 2014 to 2018. Relative to this increase, the increase in pilot pay would be about 9 percent (17 – 8).

Annual Earnings of Veterans Working as Pilots and Non-Pilots

For the DRM, we need data on earnings by age that a military pilot might expect when considering civilian opportunities. We used ACS data to estimate regressions on the earnings of pilots and non-pilots. The sample is limited to full-time, full-year workers with four or more years of college. Earnings for pilots and non-pilots are both relevant because military pilots can consider career opportunities in both domains.

Annual earnings depend on hourly pay and hours worked or, in the case of pilots, hours flown. Pilots are limited to no more than 1,000 flying hours a year. Several factors affect how many hours a pilot actually flies. Newly hired pilots have little control over their schedules and routes and may be called at the last minute to fill in for scheduled pilots who are unavailable. During this on-call phase, pilots are uncertain of the hours they will fly and whether they will be near the 1,000-hour limit. As pilots gain tenure, their control over flight schedules increases. Available choices might involve nights, weekends, or holidays, as well as flights with shorter stages. Short-stage flights tend to have fewer flying hours relative to the number of hours at work because of the waiting time between flights. Senior pilots can choose their preferred routes and schedules, and they might or might not want to reach the 1,000-hour maximum. Longer flights to desirable locations and more time at home could be preferred to higher-tempo flights to less interesting destinations. A pilot's control over routes and schedules depends on rank and tenure, and a first officer promoted to captain is at the bottom of the captain tenure list and again has the least amount of control over routes and schedules. Still, as the pilot pay scales make clear, a pilot's earnings increase with total tenure and step up upon promotion from first officer to captain.

Another factor affecting pilot earnings is that an airline does not necessarily want to maximize the flying hours of its pilot workforce. Instead, the airline wants to maximize profit. Pilots are one input, and their use must be considered along with pilot cost, locations to include in the flight network, flight frequency, and competitiveness relative to rival airlines serving the same locations and routes. It might be more profitable to have pilots on hand to meet peak-hour flight demands even if it means fewer than 1,000 hours of flying time for many pilots. To some extent, high pay scales at large airlines compensate for flexibility in using the pilots.

ACS data provide a large sample size and coverage over a number of years. They do not identify whether a person was a military pilot but do identify military veterans. For civilians employed as pilots, they do not identify whether the pilot works for a large airline or the pilot's seniority. We are interested in the expected earnings-age relationship of a military pilot who is considering working for a major airline, and to infer this, at least approximately, we assume that a veteran in his or her early 30s who reports an occupation of "pilot or flight engineer" and has annual earnings in the range of what one might expect from the pay scales at major airlines is employed by a major airline. The rationale is as follows: Military pilots complete college around age 22 and have an eight- or ten-year ADSC depending on their entry cohort as officers, making them eligible to leave the military at age 30 or 32. According to Air Force officers with whom we have spoken, military pilots wanting to be a civilian pilot will apply to major airlines. Further, the earnings of pilots at major airlines should correspond approxi-

mately to their pay scales. As mentioned, we find that this implies annual earnings around the 80th percentile for civilian earnings of veteran pilots. Because of seniority rules, a pilot at a major airline is unlikely to change airlines; as a result, age is a good proxy for tenure at the airline, which is relevant because pilot pay rates depend on tenure and not on age.[19] Thus, the estimated earnings-age relationship for veteran pilots who start their employment as civilian pilots in their early 30s and who earn at the 80th percentile is an estimate of expected earnings with respect to tenure at a major airline.[20]

It is important to keep in mind that a pilot's pay depends not on age but on tenure, regardless of the age at which the pilot starts. We take the 80th percentile earnings curve starting at ages 30 to 35 as the earnings-tenure curve for pilots from the military at those ages. By the same reasoning, a pilot leaving the military at age 42 and starting at a major airline would have the *same* earnings curve, though of course work life to age 65 (mandatory retirement) would be shorter by 10 years. For example, suppose earnings start at $100,000; an ex-military pilot hired at age 30 would earn that amount, as would an ex-military pilot hired at age 40.

We assume that military pilots consider both pilot and non-pilot career opportunities. We therefore also estimate earnings for veterans working in the civilian economy as non-pilots and compare their earnings streams to those of pilots. These comparisons assume that an outgoing military pilot going to work as a non-pilot can join the non-pilot earnings curve at his or her current age. That is, a military pilot leaving at age 37 can expect to have the civilian earnings of a 37-year-old worker with similar characteristics. The regression results support the assumption, in that there is little difference between the earnings of veterans and non-veterans in non-pilot occupations after controlling for age, education, and gender. But the results show that pilots who are veterans earn 10 to 15 percent more than non-veteran pilots, perhaps because pilots leaving the military are more likely to work for a major airline.

Predicted Pilot and Non-Pilot Earnings by Age for Veterans, by Percentile

We report the regression results and tables of predicted earnings in Appendix A. The predictions are for 2011, the last year available in the ACS data, for male veterans in 2013 dollars. There are separate tables for pilots and non-pilots, by level of education (four years of college, more than four years of college), with predicted earnings by age for the 40th through 90th earnings percentiles.[21] Figures 4.4 and 4.5 display the earnings curves for veteran pilots and veteran non-pilots, respectively, with four years of college. Although not shown, the earnings curves for pilots with more than four years of college are almost exactly the same as those for pilots with four years of college. This is what one would expect in view of the pilot pay scales,

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[19] More specifically, pay rates depend on rank and years in rank. If progression up the ranks is stable, then pay will approximately depend on tenure—i.e., total years at the airline.

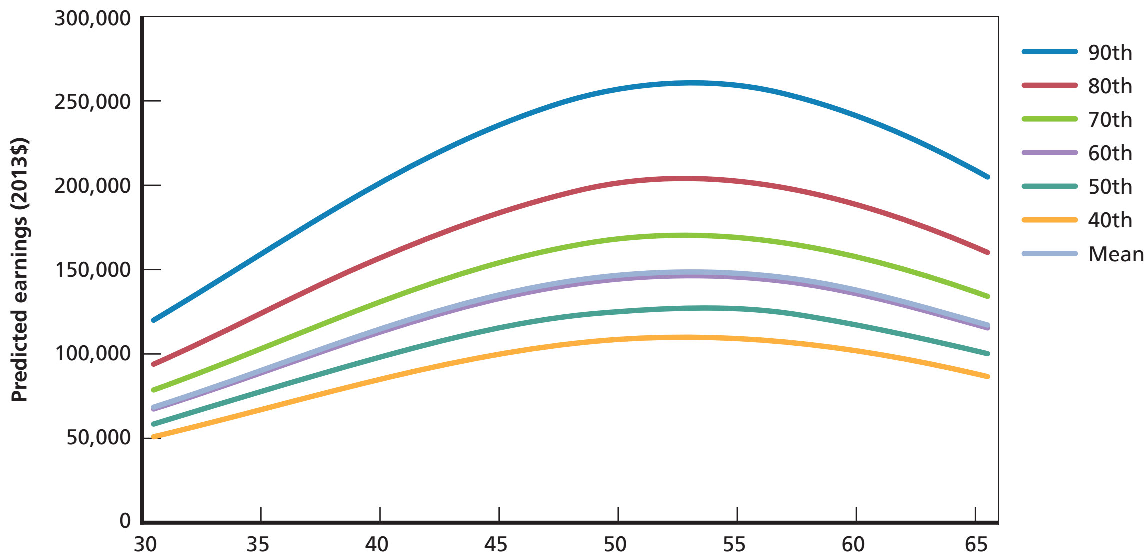
[20] We use tenure here rather than seniority to clarify that we are interested in the total years of employment with an airline. We chose not to use seniority because the pilot pay scales count seniority starting in year one for first officers and again in year one for captains.

[21] Let θ be the probability associated with a given percentile. For example, $\theta = 0.7$ relates to an earnings level at the 70th percentile of earnings. Then, if $X'\beta$ is the earnings index,

$$0.7 = \Phi\left(\frac{z_{0.7} - X'\beta}{\sigma}\right),$$

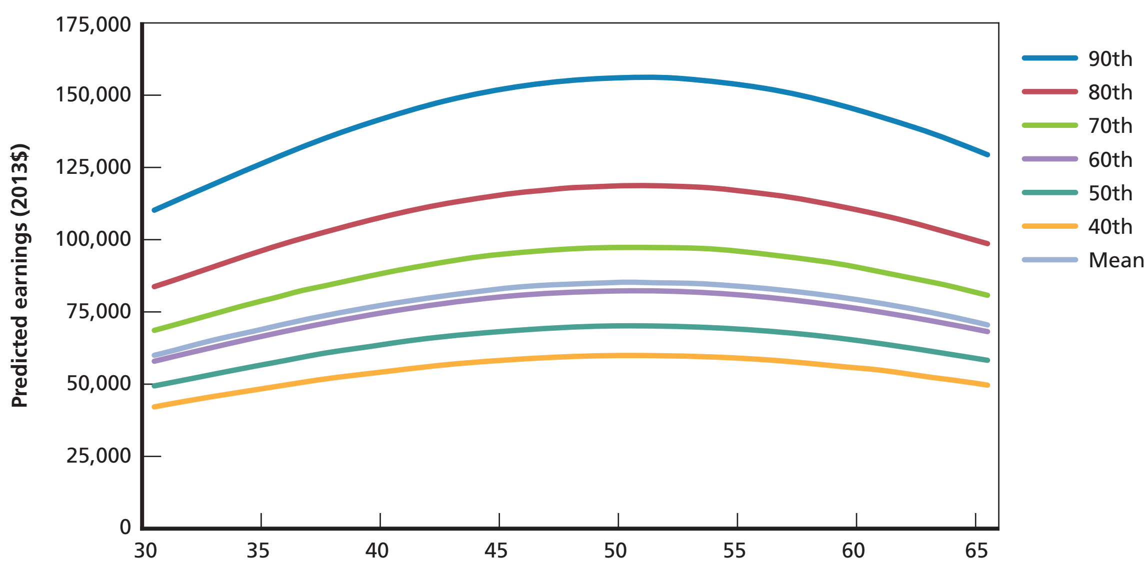
where $z_{0.7}$ is the earnings level associated with the 70th percentile and Φ is the normal distribution. Therefore, $z_{0.7} = \sigma\Phi^{-1}(0.7) + X'\beta$.

Figure 4.4
Predicted Earnings by Percentile for Male Veteran Pilots with Four Years of College, 2011 (in 2013 dollars)



SOURCE: Authors' calculations.
RAND *RR1455-4.4*

Figure 4.5
Predicted Earnings by Percentile for Male Veteran Non-Pilots with Four Years of College, 2011 (in 2013 dollars)



SOURCE: Authors' calculations.
RAND *RR1455-4.5*

which are independent of the pilot's level of education. But the earnings curves for non-pilots with more than four years of college are about 27 percent higher than those for non-pilots with four years of college. The general labor market rewards higher education with higher pay.

Earnings at the 80th percentile on this curve roughly map to the major airline pay scales and having 900 to 1,000 flying hours. For instance, in 2014 a first officer with three years of seniority who flew 950 hours in a small narrow-body aircraft would have earned $96,000 to $112,000. For a captain with 12 years of seniority, this increased to $185,000 to $202,000 for a large narrow-body aircraft and to $221,000 to $242,000 for a wide-body aircraft (Table 4.1). Predicted earnings along the 80th percentile in 2013 dollars are about $95,000 at age 33 and peak at $204,000 at ages 52 to 53.

Because pilot pay scales are defined in terms of tenure and not age, the earnings profile for veteran pilots starting in their early 30s seems best matched to identifying the earnings-tenure curve of pilots. Tenure would begin at the age of entry, say 30 or 32, depending on ADSC and age of graduation from college, and would increase with age. Pilots have little incentive to leave their jobs as pilots because non-pilot jobs pay considerably less. They also have little incentive to move from one airline to another because that requires starting at the bottom of the seniority ladder. Finally, the earnings curves at lower percentiles, while statistically accurate, will reflect the earnings composition of pilots at higher ages. For example, earnings at age 50 at the 50th percentile will reflect the earnings of pilots flying for low-paying organizations, such as regional airlines or air taxis, or doing agricultural spraying; this curve would also reflect the earnings of ex-military pilots flying for a large airline who left the military after, say 15 years of service (age 37) and now have 13 years of tenure at the airline. In contrast, an ex-military pilot who had started with a large airline at age 32 would now have 18 years of tenure. This pilot would therefore have higher pay than the pilot with 13 years of tenure, and the higher pay would place the pilot at a higher wage percentile.

In our pilot retention analysis, we use the 80th percentile curve to represent veteran earnings of pilots working at a large airline with respect to tenure. We do this by shifting the curve to the right depending on the age of exit from the military. A person leaving at age 30 would have the earnings-tenure curve shown as the 80th percentile curve in Figure 4.4, and a person leaving at age 35 would have the same curve shifted five years to the right. The tenure clock would then begin at age 35, and earnings at 35 (the first year of tenure for this person) would be the same as at age 30 if that were the first year of tenure.

Pilot earnings decline after the early 50s. At the 80th percentile, earnings decrease from $204,000 to $160,000 at age 65. Because our sample contains only full-time, full-year pilots, the decrease is not caused by working fewer weeks during the year or by working a usual work week of less than 40 hours. Usual weekly hours fell from 49.2 at ages 51 to 53 to 46.9 after age 60, a 5-percent drop, and flying hours may have decreased. This might reflect a preference to spend more time at home or to fly routes with longer layovers (and thus have fewer flying hours per hour on the job), or it may reflect more days away because of ill health or family issues, despite having a usual work week of at least 40 hours. The earnings decline could also result from a selection where pilots with high earnings potential have less propensity to work after age 50.

Earnings for veterans working in non-pilot occupations (Figure 4.5) are typically much lower than veteran pilot earnings. Along the 80th percentile, for instance, earnings peak at $120,000 at age 50. There is no longer a presumption that the veteran would be on the

80th percentile, and we use the 60th percentile of non-pilot earnings in the DRM. As the figure shows, 60th-percentile earnings are slightly below mean earnings.

An Expression for the Expected Present Discounted Value of Civilian Earnings

We now draw together the above discussion to present an expression for the expected present discounted value (PDV) of civilian earnings that incorporates both pilot and non-pilot civilian earnings. Assume that a military pilot can find civilian employment as a non-pilot with certainty and has a probability *p* of being hired by a large airline. The expected PDV of civilian earnings is then of the following form (omitting the subscript for the year/age when the pilot leaves the military):

$$PDV_{non\text{-}pilot} + p(PDV_{pilot} - PDV_{non\text{-}pilot})$$

We model the probability of an Air Force pilot being hired by a large airline as a function of large airline hiring. We adopted this approach when estimating the DRM.

CHAPTER FIVE

Evidence Related to the Demand for Pilots

This chapter is guided by the idea that the demand for pilots at large airlines depends on the growth in demand for air transportation and the need to replace pilot personnel lost to retirement or attrition.[1] We probe the demand for pilots in several ways. We analyze time series data on passenger and cargo flights and present information on aircraft size, load factor, and stage length. We report the number of pilots employed by major airlines and the projected number of pilots retiring from them. We briefly review airline bankruptcies and mergers occurring since 1990.

The key findings from this assessment are as follows:

- Based on our empirical analysis, we forecast systemwide passenger and cargo miles to grow by 33 percent from 2014 to 2025. This increase comes mainly from the expected growth in gross domestic product (GDP).[2] The growth in miles can be expected to increase the demand for pilots, other things being equal.
- However, increases in load factor, aircraft capacity, and stage length have held down the demand for pilots, despite an upward trend in passenger miles. In addition, there has been a decrease in departures; the airlines have flown more miles with fewer departures. If continued, these trends will moderate the demand for pilots.
- From 2004 to 2013, the number of pilots employed by major airlines was nearly steady at 45,000. But employment increased sharply from 2013 to 2014, rising from 44,964 to 48,495—an increase of 3,531 in one year.
- Many pilots at large airlines are nearing retirement. Annual retirements are expected to increase steadily from roughly 900 in 2014 to 2,600 in 2025. Retiring pilots must be replaced to maintain the pilot inventory.
- The past decade has been a turbulent one for large airlines. By 2013, major airlines were well along on their restructuring and seemed poised for growth in an economy emerging from the Great Recession.

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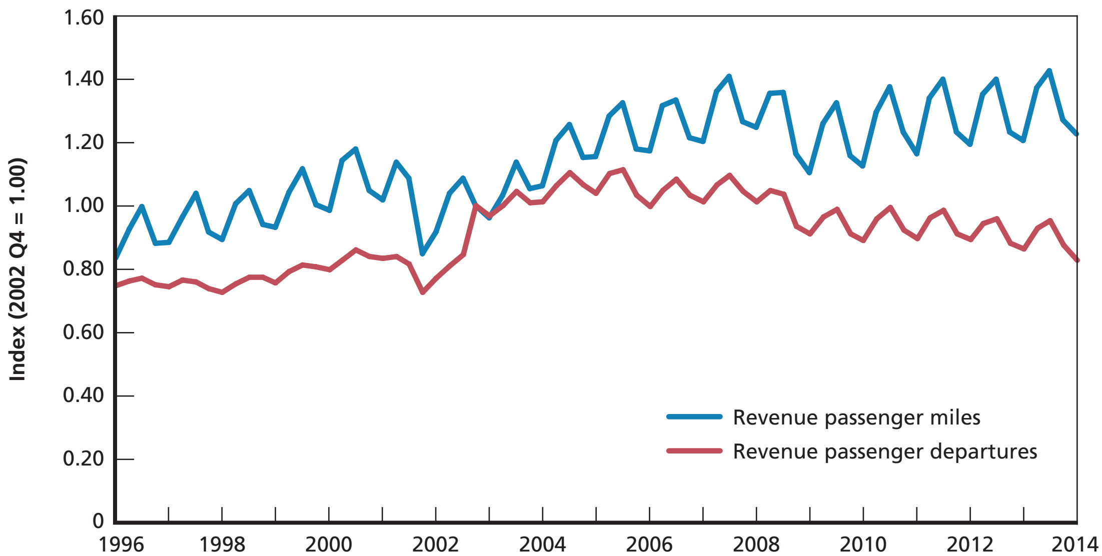
1 This point is also made in GAO, 2014.

2 In analysis not reported here, for passenger departures we forecast a small, 3-percent total increase from 2014 to 2025. However, if the trends in load factor, aircraft capacity, and stage length slow, the growth in passenger departures is likely to be greater. For cargo departures, our model forecast a 54-percent increase over this period. But statistical tests indicated that the cargo departure time series may not be stationary, in which case the forecast may not be trustworthy.

Trends in Airline Activity: Passenger and Cargo

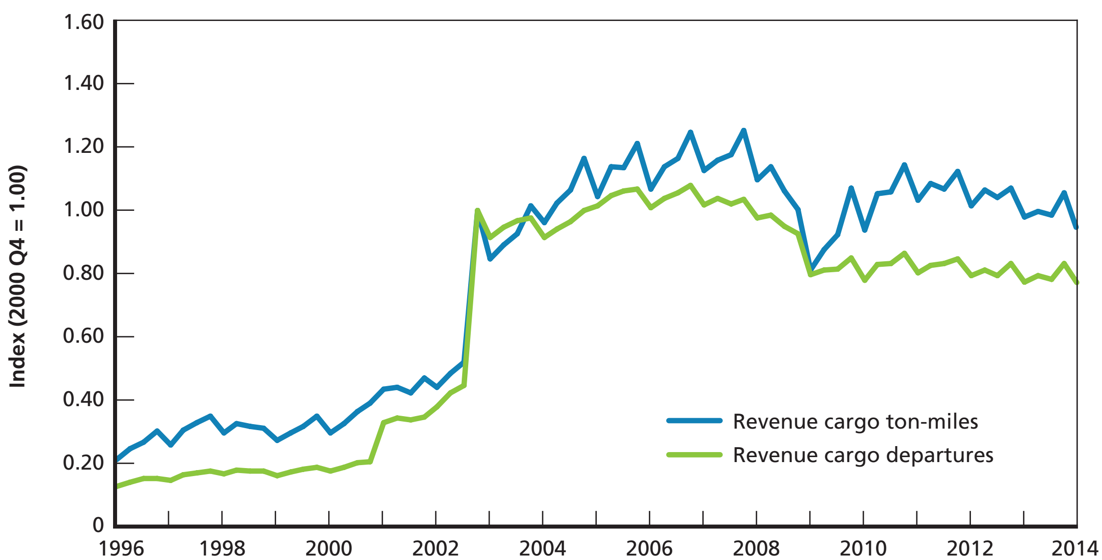
Figures 5.1 and 5.2 display systemwide revenue miles and departures for passengers and cargo, respectively, from the first quarter of 1996 (Q1) through 2014 Q1. We downloaded the data from the Bureau of Transportation Statistics and normalized the series so that 2000 Q4 equals 1.00.

Figure 5.1
Passenger Miles and Departures, 1996–2014



SOURCE: BTS, undated.
RAND *RR1455-5.1*

Figure 5.2
Cargo Ton-Miles and Departures, 1996–2014



SOURCE: BTS, undated.
RAND *RR1455-5.2*

The general trend since 1996 has been for passenger miles to increase. Exceptions to the trend occurred in the early 2000s as the economy entered a recession, in 2002 as United Airlines entered bankruptcy, and in 2008 at the start of the Great Recession. Departures of passenger aircraft increased at first but have trended down since 2005.

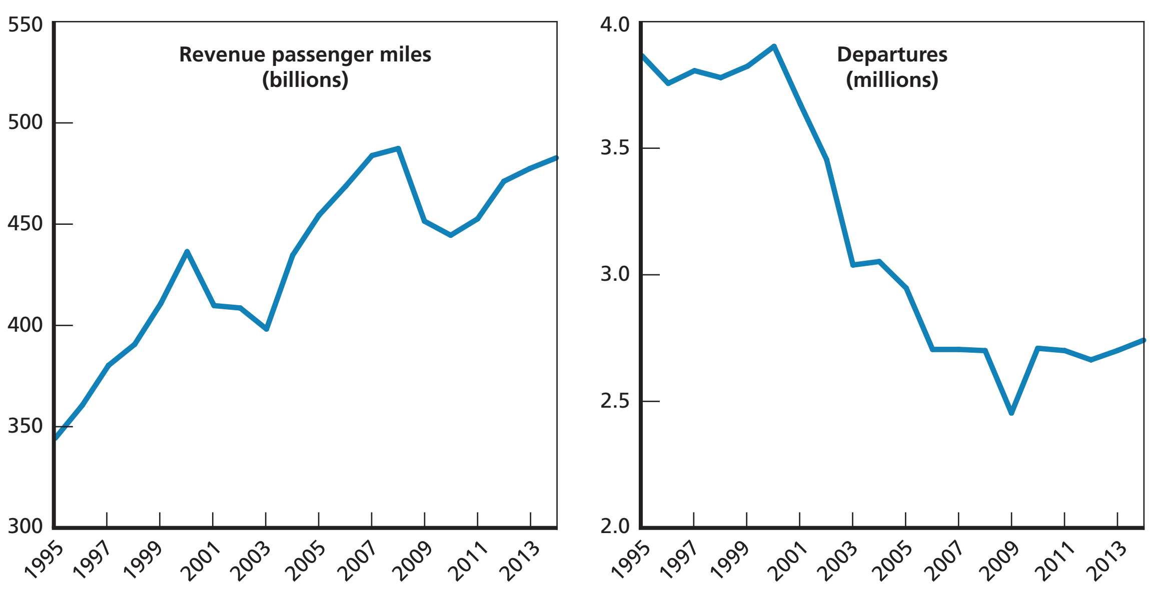
Cargo ton-miles and cargo departures increased through 2006. This can be seen if one visually adjusts for the upward shift in the cargo series at the end of 2002, which occurred because of a change in the reporting protocol. Both fell in 2008, and ton-miles have recovered since then, while cargo departures have decreased. Ton-miles were 7 percent lower in 2014 Q1 than in 2002 Q4, while passenger miles were 23 percent higher. Ton-miles were 3 percent of total (passenger and cargo) miles in 2014 Q1. Cargo departures were 7 percent of total departures in 2014 Q1. Given the small percentages for cargo, our discussion focuses on passenger and cargo miles.

Quarterly variation in passenger miles is greater than for departures. This suggests that airlines tend to maintain their flight schedules in the face of quarterly changes in the number of passengers. Therefore, pilot hours are probably little affected by seasonality.

With respect to American/US Airways, Delta/Northwest, and United/Continental, passenger miles increased from 1995 onward, with temporary decreases in the recessions beginning in 2001 and 2008 (Figure 5.3). The increase in passenger miles from 1995 to 2014 was 40 percent. Departures decreased by 29 percent from 2000 to 2006, hit a low point in 2009, and returned to 2003 levels by 2013. The decrease in departures from 1995 to 2013 was 12 percent.

Three factors help to explain the simultaneous increase in passenger miles and decrease in departures since 2005. These are aircraft capacity (measured as seats per departure), load factor, and stage length. A stage is a flight segment from point A to point B, and a stage could be a passenger's entire flight or part of a longer flight with one or more stops. All three factors

Figure 5.3
American, Delta, and United Passenger Miles and Departures, 1995–2014



SOURCE: MIT Airline Data Project, undated(b), undated(c), and undated(d).
RAND *RR1455-5.3*

have increased since 1995 for American, Delta, and United (Figure 5.4).[3] Seats per departure increased from about 160 in 2001 to 183 in 2014, a 10-percent increase. These airlines apparently shed smaller, less fuel-efficient aircraft, and fuel efficiency improved by 13 percent over the entire period, with the actual increase starting in 2001.[4] Their load factor grew from 0.67 in 1995 to over 0.84 in 2014, a 25-percent increase.[5] They also increased their average stage length by serving more international destinations and decreasing certain short-haul flights, which meant less air service for smaller cities feeding into the larger hubs.[6] The average stage length rose by 53 percent from 1995 to 2014.[7]

Thus, from 1995 to 2014 these airlines increased passenger miles by 40 percent and decreased departures by 29 percent. Increases in aircraft size, load factor, and stage length helped to enable these remarkable changes and at the same time suppressed the demand for additional pilots to fly the greater number of miles. Based on Bureau of Transportation Statistics data (compiled by the MIT Airline Data Project), the number of pilots employed by these airlines was 39,403 in 1995, 32,817 in 2013, and 34,320 in 2014, while the total number of pilots employed by large passenger airlines for these years was 42,620, 46,206, and 48,495 (Figure 5.5).

The demand for pilots can be expected to increase with the demand for air transportation, but it clearly also depends on seats per departure (and fuel efficiency), load factor, and stage length, all of which are managed by each airline. Stage length is an indirect indicator of the airline's network of scheduled flights and locations served. One way to continue the upward trend in stage length is for large airlines to outsource feeder routes to regional affiliates (e.g., United Express). This has been done to some extent, as suggested by the increase in pilots employed by airlines other than by the merged versions of American, Delta, and United. The number of seats per departure is related to network decisions and the replacement of aging, inefficient aircraft, as well as trimming shorter, less profitable stages. Airlines might prefer larger aircraft to handle the growth in passenger demand by node and thereby avoid the need to schedule more flights and use more pilot time to fly them.

Load factor and stage length trends seem to have slowed in recent years (Figure 5.4). Ever-higher load factors displease customers dreading crowded aircraft with little space for carry-ons, make the work of flight attendants more difficult, and frustrate pilots and crews whose performance is judged in part by on-time departures. High load factors cause problems when a flight is canceled because there are fewer available seats on substitute routing. Trying to squeeze more passengers into the remaining seats can again lead to unpleasant boarding experiences and added work for flight crews and agents handling the reticketing. The likelihood of further increases in stage length depends on the profitability of further pruning the network.

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3 The data are from the MIT Airline Data Project (undated[a]).

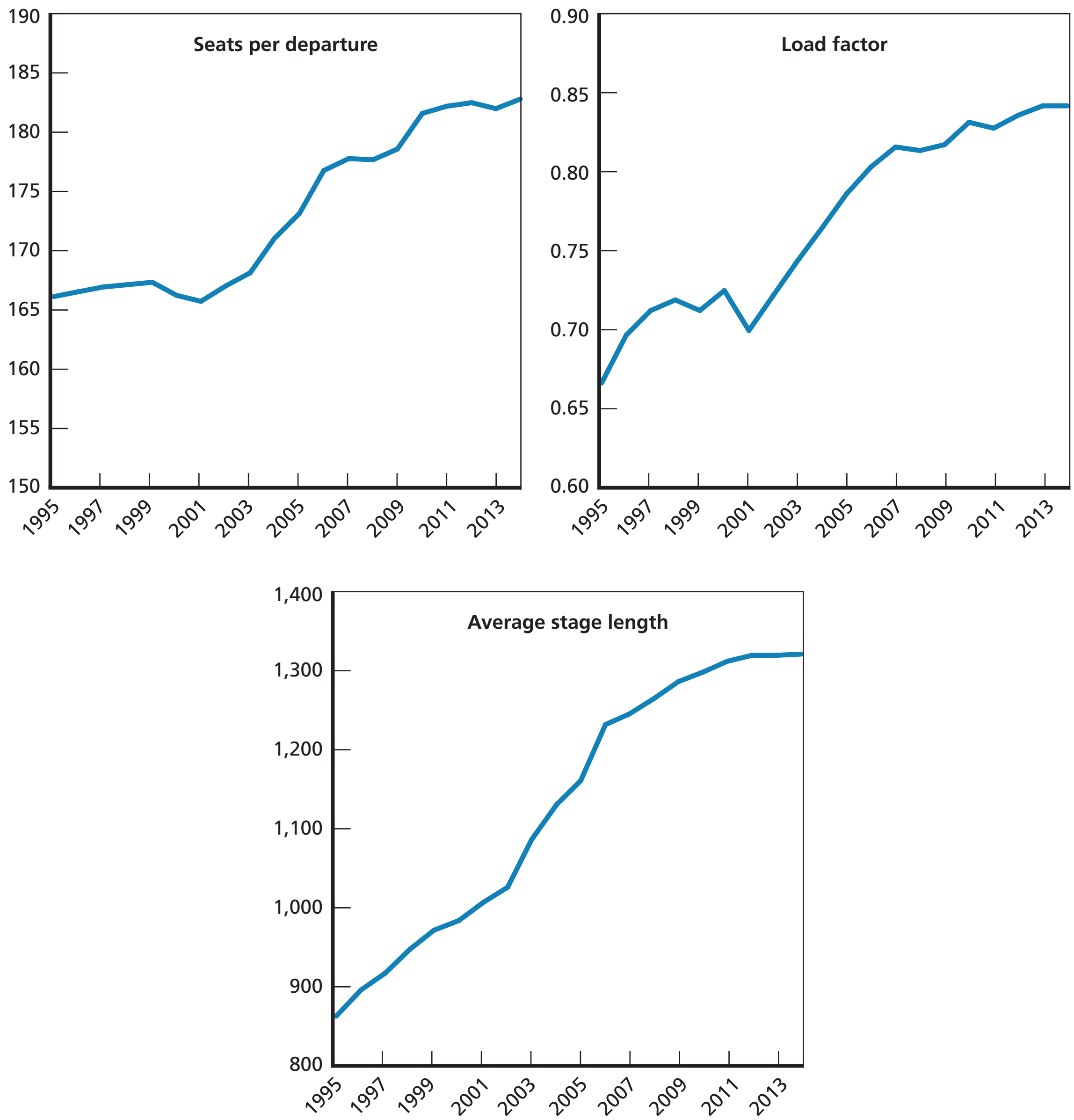
4 The airlines' measure of fuel consumption is gallons of fuel per block hour. Using a weighted average of fuel consumption by large passenger airlines, where the weights are based on departures, gallons per block hour were around 1,100 in the late 1990s and just over 950 in the past few years, a 13-percent decrease. Data on fuel per block hour are from the MIT Airline Data Project (undated[a]).

5 We computed seats per departure, load factor, and average stage length as a weighted average of each airline's load factor, basing the weights on departures.

6 In February 2014, United announced plans to "cut 60% of its flights from its Cleveland hub by June. Big airlines have been shutting their smallest hubs for financial reasons for years, and United blamed the decision partly on weak demand in Cleveland, which it said hasn't been profitable in more than a decade" (Carey and Nicas, 2014).

7 Again, this percentage is a weighted average of stage length by airline, with weights based on departures.

Figure 5.4
American, Delta, and United Aircraft Size, Load Factor, and Stage Length, 1995–2014

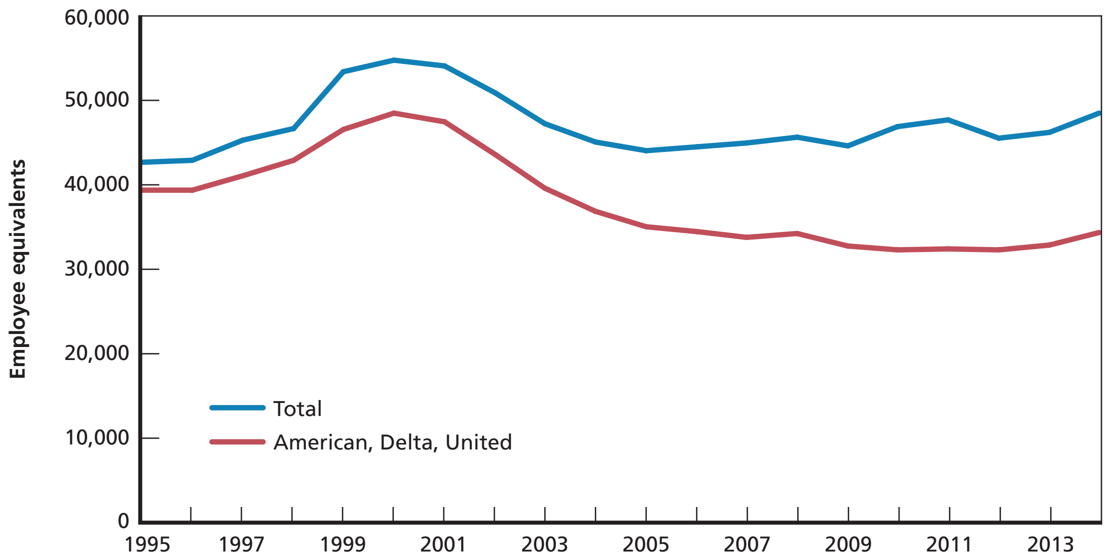


SOURCE: MIT Airline Data Project, undated(b), undated(c), and undated(d).
NOTES: American includes US Airways and America West, Delta includes Northwest, and United includes Continental. Other airlines are Southwest, JetBlue, AirTran, Frontier, Virgin America, Alaska, Hawaiian, and Allegiant.
RAND *RR1455-5.4*

An implication is that the airlines may be nearing the end of maximizing the use of their carrying capacity, given their route structure, and adding capacity may mean more aircraft, more flights, and more crews—including more pilots.

We next estimated regression models of systemwide passenger and cargo miles. We then forecast miles for an upper bound on the increase in pilot demand apart from replacing pilots that retire. Increases in aircraft capacity, load factor, and stage length can be expected to keep

Figure 5.5
Pilot and Co-Pilot Employee Equivalents at Major Airlines, 1995–2014



SOURCE: MIT Airline Data Project, undated(a).
NOTES: American includes US Airways and America West, Delta includes Northwest, and United includes Continental. Other airlines are Southwest, JetBlue, AirTran, Frontier, Virgin America, Alaska, Hawaiian, and Allegiant.
RAND *RR1455-5.5*

the increase in pilot demand below this forecast, as noted. It is also reasonable to expect airline personnel managers to manage the pilot workforce efficiently in the face of these changes.[8]

Regression Models of Passenger and Cargo Miles

We estimated regression models for passenger and cargo miles, where economic activity and production cost were the explanatory variables.[9] The data are for the U.S. airline industry and are from the Bureau of Transportation Statistics.[10] The basic specification is log-log:

$$\ln(y_t) = \alpha + \beta_1 \ln(GDP_t) + \beta_2 \ln(PPI_t) + u_t$$

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[8] Verbeek (1991) discusses decision support systems for manpower planning of airline pilots. He describes linear programming models that address the questions of when to schedule transition training for pilots to a higher position (first officer to captain) and to a larger aircraft, and when to hire new pilots, in a way that minimizes surpluses and shortages of pilots over a planning horizon of approximately ten years and under different scenarios. The approach takes into account the seniority system for pilots—i.e., pilots with the greatest seniority in a position have the highest probability of being selected for transition training. He points out that airlines routinely use such models to schedule their pilot training and hiring efficiently and in harmony with plans for airline fleet growth and changes in a network of scheduled flights.

[9] The miles series data are for revenue miles.

[10] Bureau of Transportation Statistics, 2016.

Economic activity is measured by GDP, and production cost is measured by the producer price index (PPI) for scheduled air passenger transportation. Various specifications also include quarterly dummies to control for seasonality and an indicator for quarters beginning with 2002 Q4, the quarter in which the cargo reporting protocol changed. Because the data are time series, we tested whether the time series of the error in the regression was stationary. The test was based on a separate regression of the change in the regression residual on the lagged residual.[11] If the error is stationary, model predictions will follow the past trend rather than possibly shifting to a different trend after a shock; stationarity is important if predictions of future outcomes based on an analysis of past time series are to be credible.

Table 5.1 shows the regression results for passenger and cargo miles. In the log-log specification, the GDP and PPI coefficients can be interpreted as elasticities. In column 1, for instance, a 1-percent increase in GDP is associated with a 1.31-percent increase in passenger miles, and a 1-percent increase in PPI is associated with a 0.17-percent decrease in passenger miles. The passenger miles models in columns 1 and 2 reject the null hypothesis of a unit root and therefore are consistent with the error being stationary. This hypothesis is not rejected in column 3, however, which is based on a shorter time series from 2002 Q4 onward. Also, the GDP and PPI coefficients in column 3 are much larger than those in columns 1 and 2 and may be suspect. Of these three models, the GDP and PPI estimates in columns 1 and 2 are quite close, so the models would be equally good for forecasting, and we prefer the model in column 1 because of its higher significance in rejecting the unit-root hypothesis.

The cargo ton-mile models are in columns 4 through 6. The unit-root null hypothesis is not rejected in columns 5 and 6 but is rejected in column 4 at the 5-percent level. The estimates in column 5 for GDP, PPI, and the 2002 Q4+ indicator are nearly the same as those in column 4, but since column 4 rejects the unit-root null hypothesis we prefer it to column 5. In column 4, the GDP elasticity is 2.58 and the PPI elasticity is –0.51. These elasticities are much larger in absolute value than those for passenger miles. Our preferred models of passenger miles and cargo ton-miles are those in columns 1 and 4.[12]

Forecasts of Passenger and Cargo Miles

We used the estimated models to forecast miles and departures through 2025 (Table 5.2). Passenger miles are the vast majority of miles and play a large role in the forecast. We used

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[11] If two time series x_t and y_t are cointegrated, a linear combination of them must be stationary. In our regression, the relevant time series are y_t and $\beta' x_t$, and if they are cointegrated the error $\varepsilon_t = y_t - \beta' x_t$ is stationary. However, β is unknown. But it can be estimated by ordinary least squares, and an estimate of the error term can be obtained: $z_t = y_t - \beta' x_t$. A stationary series has the property that a large shock in one period tends to be followed by a lower shock in the next period. In the regression $z_t = \beta z_{t-1} + v_t$, one would then expect $\beta < 1$, but if $\beta = 1$ the series would not be stationary. Transforming this specification by subtracting z_{t-1} from both sides gives $\Delta z_t = \gamma z_{t-1} + v_t$ where $\gamma = \beta - 1$, and the test for stationarity is a test of the null hypothesis that $\gamma = 0$. Because $\gamma = 0$ when $\beta = 1$, this is also a test of whether the error series has a unit root. Granger and Engel (1985) describe this model in full generality and recommend using augmented Dickey-Fuller critical values in testing the null hypothesis, which we use. We would like to reject the null hypothesis to have assurance that y_t and $\beta' x_t$ are cointegrated and ε_t is stationary; that is, we would like to reject the null hypothesis of a unit root.

[12] We estimated similar models for departures. The unit-root null hypothesis is not rejected in any of the cargo departure models, which creates the concern that cargo departure forecasts based on these models are not reliable.

Table 5.1
Air Passenger Miles (PM) and Air Cargo Ton-Miles (CTM) Regression Models (t-statistic in parentheses)

	ln(PM)	ln(PM)	ln(PM)	ln(CTM)	ln(CTM)	ln(CTM)
	1	2	3	4	5	6
Constant	7.51	7.73	1.49	–6.88	–5.51	–3.44
	(3.19)	(6.03)	(1.25)	(–1.79)	(–1.49)	(–0.91)
ln(GDP)	1.31	1.28	2.03	2.58	2.37	2.53
	(4.01)	(7.21)	(12.80)	(4.84)	(4.63)	(5.06)
ln(PPI)	–0.17	–0.18	–0.36	–0.51	–0.41	–0.93
	(–1.06)	(–2.09)	(–5.27)	(–1.96)	(–1.64)	(–4.35)
Q2		0.11	0.11		0.07	0.07
		(8.31)	(11.88)		(1.84)	(2.17)
Q3		0.14	0.14		0.08	0.06
		(10.86)	(15.08)		(2.06)	(1.99)
Q4		0.01	0.02		0.12	0.11
		(1.04)	(2.11)		(3.15)	(3.64)
2002 Q4+	0.00	0.02		0.77	0.78	
	(0.05)	(0.81)		(13.19)	(13.95)	
R squared	0.73	0.93	0.95	0.96	0.96	0.52
ADF significance	1%	10%	n.s.	5%	n.s.	n.s.
Number of observations	73	73	46	73	73	46
Period	1996 Q1–2014 Q1	1996 Q1–2014 Q1	2002 Q4 – 2014 Q1	1996 Q1–2014 Q1	1996 Q1–2014 Q1	2002 Q4–2014 Q1

NOTES: ADF = augmented Dickey Fuller test; n.s. = not statistically significant.

the CBO forecast[13] of GDP and based the PPI forecast on its average annual growth over our data period. The forecast was done as an index number with a base of 100 in 2014 for passenger miles and cargo-ton miles. Real GDP grew by 2.4 percent in 2014 and 2015. The CBO GDP forecast is 2.7 percent in 2016; 2.5 percent in 2017; and 2.0 percent in 2018, 2019, and 2020. We assumed that 2.0 percent would prevail from 2021 to 2026. PPI growth since 1996 has been fairly steady; a simple regression of log PPI on a constant and time has an R-squared value of 0.95 and indicates an average annual growth rate of 3.9 percent. We used this percentage in the left panel of Table 5.2. However, the recent (spring 2015) drop in the price of oil suggests a decrease in airlines' PPI. In 2014, fuel accounted for 29 percent of airlines' oper-

[13] Congressional Budget Office, 2016.

Table 5.2
Forecasts of Passenger and Cargo Miles, 2014–2025

	CBO GDP, 3.9% PPI				CBO GDP, 2% PPI			
Year	Passenger miles	Cargo ton-miles	Cargo fraction	Weighted average	Passenger miles	Cargo ton-miles	Cargo fraction	Weighted average
2014	100	100	0.07	100.0	100	100	0.07	100.0
2015	102	104	0.07	103	103	105	0.07	103
2016	105	108	0.07	105	105	110	0.07	106
2017	108	113	0.08	108	108	115	0.08	109
2018	110	118	0.08	111	111	120	0.08	112
2019	112	121	0.09	113	113	124	0.09	114
2020	114	124	0.09	115	115	128	0.10	117
2021	116	127	0.10	117	118	131	0.11	119
2022	118	131	0.11	120	120	135	0.12	122
2023	120	134	0.12	122	122	139	0.14	124
2024	122	137	0.13	124	124	142	0.15	127
2025	124	140	0.15	127	126	146	0.17	130

NOTE: This table uses an index number with a base of 100 in 2014 for passenger miles and cargo-ton miles.

ating costs.[14] If there were zero increase in the price of fuel and if the other components of PPI increased at 3.9 percent, the overall increase in PPI would be 2.8 percent. These are arbitrary assumptions, but we can use them to see how this lower rate of PPI increase would affect the forecast (right panel of Table 5.2).

The forecast increase in passenger miles from 2014 through 2025 is 24 to 26 percent, and the forecast increase in cargo miles is 40 to 46 percent. Cargo's share of miles increases from 7 percent to 15–17 percent. The weighted average of growth in miles is 27 to 30 percent. We caution that the forecast growth in cargo reflects the fast growth in this industry over the past 20 years, a pace of growth that might not continue into the future. The passenger mile forecast is affected by the slowdown in the recession, which suggests that future growth might be higher than the forecast.

Forecasts are also available from Airbus and Boeing for North America (Airbus, 2013; Boeing, 2014). The Airbus forecast for passenger miles was 3.6 percent per year from 2013 through 2022 and 3.3 percent from 2023 through 2032. The Boeing forecast was 2.9 percent per year from 2013 through 2033. The Airbus cargo forecast (worldwide only) was 4.8 percent per year from 2013 through 2032, and the Boeing cargo forecast for North American was 3.4 percent from 2013 through 2033. Our forecasts imply average annual increases of 2.0–2.1 percent for passenger miles, 3.1–3.4 percent for cargo, and 2.2–2.4 percent overall. These growth rates are less than those of Airbus and Boeing.

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14 MIT Airline Data Project, undated(a).

Bankruptcies

Recessions, bankruptcies, mergers, and acquisitions buffeted the airline industry in the 1990s and 2000s. Airlines for America, a trade association, estimated that there have been 116 U.S. airline bankruptcies since 1990. The majority of these were filed as Chapter 11 for reorganization, but 15 were filed as Chapter 7 and led to liquidation. The peak years for bankruptcies were 1991, with 16, and 2008, with 13, and in most years there were at least two bankruptcies. Four large airlines were bankrupt in 2005: United, US Airways, Northwest, and Delta. United entered bankruptcy in 2002 and merged with Continental in 2010. Delta acquired Northwest in 2008, and American merged with US Airways in 2013. Signaling the end of a turbulent era, there were no bankruptcies in 2014. Figure 5.6 shows bankruptcies by year.

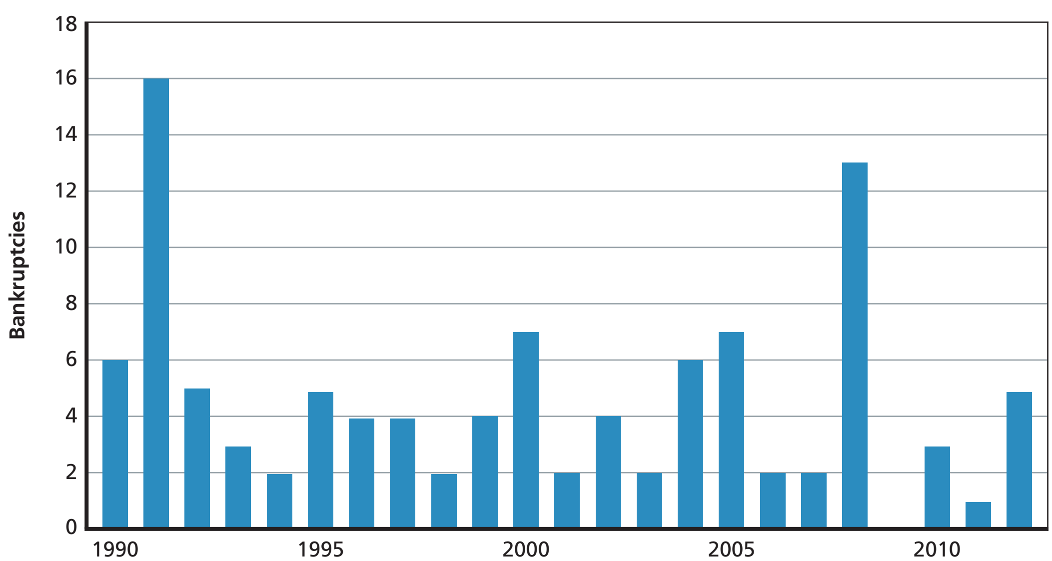
Many bankrupt airlines restructured to return to profitability by cutting less profitable routes and furloughing pilots. This was the case with American Airlines, United, and Delta. By 2013, these airlines had recalled or offered to recall all of their furloughed pilots.

The Coming Wave of Civilian Pilot Retirements

FAA increased the mandatory retirement age for pilots from age 60 to 65 in 2007. Many pilots are now approaching age 65, and, as a result, retirements at large airlines will increase steadily. Forecast retirements grow from 924 in 2014 to 2,612 in 2025 (Figure 5.7).

The figure implies that the pilot population is aging on average, and this is echoed in the ACS data. We used ACS data to tabulate the percentage of pilots aged 50 or older. This percentage has increased from 27 percent in 2005 to 30 percent in 2010 and 37 percent in 2011.

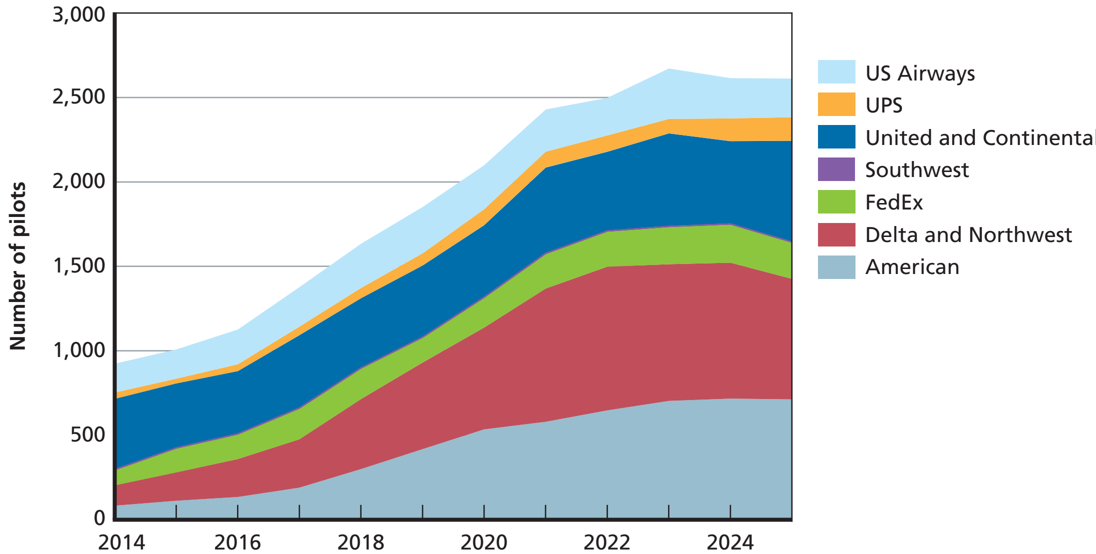
Figure 5.6
U.S. Airline Bankruptcies, 1990–2013



SOURCE: Airlines for America, undated.

RAND *RR1455-5.6*

Figure 5.7
Number of Pilots Projected to Retire from Large Airlines, 2014–2025



SOURCE: Airline Pilot Central, 2016.
NOTE: Southwest data are missing.
RAND *RR1455-5.7*

Pilot Attrition

Attrition also decreases the inventory of pilots.[15] High pay scales at major airlines and the seniority system provide incentives to keep pilot attrition low. A spokesperson at a large airline suggested an attrition rate of 0.5 percent. At this rate, 250 pilots leave each year and need to be replaced to maintain the pilot workforce.

Attrition and mandatory retirements will increase the replacement demand from 1,174 in 2014 to 2,862 in 2025 (Table 5.3). According to FAPA data (Figure 3.5), large airlines hired 3,053 in 2014. This is 1,879 more (3,053 – 1,174) than the replacement demand.

Closing Comment

Pilot hiring will grow over the next ten years because of pilot retirements and growth in air transportation, which we estimate to be close to 30 percent. Whereas retirements create an additional replacement requirement on top of attrition, growth in air transportation will require more capacity. More capacity can be obtained by more intensive use of existing aircraft and the purchase of new aircraft. The new aircraft can replace older, less efficient, and smaller aircraft with larger, more efficient, modern versions and/or increase the number of aircraft in an airline's fleet. Increases in aircraft size, load factor, and stage length, as well as decisions on which markets to enter or leave, may moderate the increase in pilot hiring, however.

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[15] Higgins et al. (2013) estimated an attrition rate of 1.5 percent. However, this was based on the entire ATP pilot and non-ATP pilot population (over 263,000 pilots) and may not be a good estimate for large airlines, which differ from other organizations in compensation level and personnel policy.

Table 5.3
Annual Replacement Demand, 2014 Through 2025

Year	Attrition	Retirement	Total
2014	250	924	1,174
2015	250	1,008	1,258
2016	250	1,126	1,376
2017	250	1,377	1,627
2018	250	1,634	1,884
2019	250	1,851	2,101
2020	250	2,099	2,349
2021	250	2,429	2,679
2022	250	2,498	2,748
2023	250	2,672	2,922
2024	250	2,615	2,865
2025	250	2,612	2,862

SOURCE: Retirements from Airline Pilot Central, 2016.

CHAPTER SIX

Dynamic Retention Model Overview, Estimates, and Model Fits

This chapter presents empirical results from applying the DRM to USAF pilots. We provide a brief overview of the basic DRM, described in more detail in several previous reports (see, among others, Asch et al., 2008; Mattock, Hosek, and Asch, 2012). The chapter then describes an innovation in the DRM that we have used in recent work, where we incorporate the ARP/contract length choice. This choice is available to pilots after completion of the ADSC incurred after completing flight school. The ADSC was eight years of service before the year 2000 cohort and was ten years thereafter. Flight school takes about a year. Thus, pilots in cohorts before 2000 typically completed their ADSC in the ninth YOS, and pilots in cohorts thereafter typically complete their ADSC in the 11th YOS. The ARP/contract length choice available to pilots may entail a three-year, five-year, or until-20-years-of-aviation-service (until-20-YAS) obligation, undertaken voluntarily. The methodology follows Mattock and Arkes (2007), which models the five-year and 20-year commitments associated with ARP for USAF pilots. As in this earlier study, we modeled pilots as facing a choice of taking a financial benefit but also committing to a service obligation and therefore forgoing the opportunity to leave the service and take advantage of an unexpected good external offer.

We extended the DRM for USAF pilots in a number of ways. First, we updated the data by estimating our model using data from 1990 through 2012. Second, we incorporated a new method to model the pilot's choice of a multi-year contract under the ARP program. Rated personnel who choose a longer contract receive ARP for more years, but because they are under contract, they forgo the opportunity to take advantage of better opportunities that might present themselves during the contract period. The new method recognizes that the multi-year contract length choice is a nested choice made under uncertainty. This extension requires estimation of an additional parameter in the model, related to the variance of the shock associated with the multi-year contract choice.

Third, we extended the model to consider multiple entry cohorts, specifically the 1990 through 2000 officer entry cohorts. Doing so permitted us to incorporate changes in USAF ARP policy that occurred in the 2000s and changes in military pay since 1990. Incorporating these changes meant that we had to incorporate an additional time clock into the model that we estimated: entry cohort date. Given entry cohort date and the other time clocks in the model for years of active service, years of reserve service, and total time elapsed, we could infer calendar year in the model. Finally, it incorporates features of the civilian pilot opportunities available to USAF pilots who leave the Air Force, including non-pilot earnings, pilot earnings, the probability of being hired by large airlines, and the unemployment rate. The updated and extended DRM produces an excellent fit of the actual data, and all of the parameter estimates are statistically significant.

The chapter begins with a description of special and incentive pays available to rated personnel and includes a description of how the features of the ARP menu changed over time. We then provide a general overview of the DRM, the data used to estimate the model, the extension of the DRM to the ARP choice, and the modeling of expected civilian pay. Next, we extend the model to include the entry cohort time clock, which accounts for changes over the data period in the military and civilian opportunities available to pilots. The chapter then presents parameter estimates and shows model fit for each application.

Special and Incentive Pays for Rated Personnel

Table C.1 in Appendix C enumerates the various contracts that were offered and the eligibility rules from 2000 through 2012, based on records available at the Air Force Personnel Center (AFPC). There are two main sets of incentive pays for rated personnel, aviator pay (AP), and aviator retention pay (ARP).[1] Historically, all rated personnel have received AP, which both compensates for a career that is more hazardous than most military careers and provides a retention incentive. AP provides up to $840 a month for midcareer officers.

ARP is received by rated personnel who commit to a multi-year obligation and typically varies with the occupation and length of the obligation incurred; three common options that have been offered to pilots have been a three-year contract, a five-year contract, and an until-20-YAS contract at amounts of up to $25,000 per year. The until-20-YAS contract means that the pilot will get the ARP if he or she stays in the military until reaching 20 years of service. In addition, ARP recipients have sometimes been offered the option to take up to 50 percent of the stream of future payments up front as a lump sum, with the remainder paid out over the length of the contract.

The ARP program has varied considerably over the years as Air Force personnel managers have adjusted eligibility rules and the menu of contracts offered in response to outside market forces and Air Force personnel retention needs. From 2000 through 2004, the Air Force offered three-year, five-year, until-20-YAS, and until-25-YAS contracts with pay up to $25,000 per year for both aviators who were initially eligible and those who were beyond their initial eligibility. Initially eligible officers are those who have completed their initial active-duty service commitment and are given a one-time choice of an ARP/contract length. Beyond initially eligible officers are those who have completed their first ARP/contract length obligation and have the opportunity to choose another ARP/contract length.

From 2005 to 2008, the Air Force offered only a five-year contract at $25,000 a year, and that only to individuals who were at their initial eligibility. From 2009 to 2012, the Air Force expanded the portfolio of contracts offered to include, at first, retirement-eligible individuals and then individuals who were not retirement eligible and not currently under a contractual obligation, offering three-, four-, and five-year contracts of $15,000 per year. Finally, in 2013, the Air Force reintroduced the until-20-YAS option at $25,000 per year for some rated occupations.

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[1] Historically, these have also been denoted as aviator continuation pay (ACP) or aviation career continuation pay (ACCP) and aviation career incentive pay (ACIP), respectively.

Dynamic Retention Model Overview

The DRM is a stochastic dynamic programming model of the decision to stay or leave military service. The model is formulated in terms of the parameters that underlie the retention decision processes.

The model begins when individuals first join the active component. In each period, an individual can choose to continue in the active component or to leave the active component. If he or she leaves, he or she can then decide whether to hold only a civilian job or to hold a civilian job and also to participate in the reserve component.[2] Once the individual has left the active component, he or she cannot return; however, he or she can move back and forth between the reserve component and civilian states.

We denote the value of staying active at time *t* as

$$V_t^S = V_t^A + \varepsilon_t^A ,$$

where V_t^A is the nonstochastic value of the active alternative and ε_t^A is the random shock at time *t*. Similarly, the value of leaving at time *t* is

$$V_t^L = \max[V_t^R + \omega_t^R , V_t^C + \omega_t^C] + \varepsilon_t^L ,$$

where the member can choose either to enter reserve service or to exit the military completely and be a civilian. The value of the former is given by $V_t^R + \omega_t^R$, while the value of the latter is given by $V_t^C + \omega_t^C$. We model the reserve/civilian choice as a nest, and, given our assumption that the stochastic terms follow an extreme value distribution, we model these as a nested logit. The within-nest shocks to the reserve/civilian choice are given as ω_t^R and ω_t^C, while the nest-specific shock is given by ε_t^L.

The shock terms in the model represent environmental shocks and may include a good assignment; a dangerous mission; a strong or weak civilian job market; an opportunity for promotion; the choice of location; a change in marital status, dependency status, or health status; or the prospect of deployment or deployment itself. We allow one common shock across the reserve and civilian nest, ε_t^L, since an individual in the reserves also holds a civilian job, as well as two shock terms that are specific to the reserve and civilian sectors, ω_t^R and ω_t^C. The individual is assumed to know the distributions that generate the shocks, which are assumed constant over time, and to know the shock realizations in the current period, but not in future periods. Depending on the values of the shocks in a future period, any of the alternatives—active, reserve, or civilian—might be the best at the time. Once a future period has been reached and the shocks are realized, the individual can reoptimize (i.e., choose the alternative with the maximum value at that time).

We assume that the shocks have extreme value distributions, and, as mentioned, the civilian and reserve choice is nested. The extreme value distribution, denoted as *EV*, has location parameter *a* and scale parameter *b*; the mean is given by $a + b\phi$, where ϕ is Euler's gamma (~0.577), and the variance is given by $\pi^2 b^2/6$. As we derive in past studies (see, for example, Asch et al., 2008), this implies the following:

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[2] In our implementation of the model, we combined the Air Force Reserve Component and the Air National Guard.

$$\varepsilon_t^A \sim EV\left[-\phi\sqrt{\lambda^2+\tau^2}, \sqrt{\lambda^2+\tau^2}\right]$$
$$\omega_t^R \sim EV[-\phi\lambda, \lambda]$$
$$\omega_t^C \sim EV[-\phi\lambda, \lambda]$$
$$\varepsilon_t^L \sim EV[-\phi\lambda, \tau],$$

where λ is the scale parameter of the distribution of ω_t^R and ω_t^C and τ is the scale parameter of the distribution of ε_t^L. Because of the nesting structure of the model, this implies that the scale parameter of ε_t^A is $\sqrt{\lambda^2+\tau^2}$. For convenience, we define $\kappa = \sqrt{\lambda^2+\tau^2}$ and refer to it as the scale parameter for the total error.

The value of the alternatives, V_t^A, V_t^R, and V_t^C, depend on the current-period pay associated with serving in an active component or working as a civilian, W_t^a or W_t^c. If the individual is a reservist, he or she earns the civilian wage plus reserve pay, $W_t^c + W_t^r$. In addition, each individual has a "taste" for active and reserve duty, γ_a and γ_r, respectively, and these enter the value functions as well. Each taste represents the net advantage of holding an active or reserve position, relative to being a civilian. Previous estimates have typically shown average taste for active and reserve duty to be negative, suggesting that military pay must compensate for the hardships and risks associated with service. All else equal, a higher taste for active or reserve duty increases retention. These tastes are assumed to be constant for each individual over time but may vary across individuals. We do not observe these tastes; rather, we assume that they have a bivariate normal distribution over active component entrants and estimate their means (denoted μ_a and μ_r for active and reserve duty, respectively), their standard deviations (denoted σ_a and σ_r), and the correlation between active and reserve tastes (denoted ρ).

The nonstochastic value of staying active can therefore be written as

$$V_t^A = \gamma_a + W_t^a + \beta E\left[\max[V_{t+1}^L, V_{t+1}^S]\right],$$

where β is the personal discount factor.

The expected value of the best choice in the next period, $E\left[\max[V_{t+1}^L, V_{t+1}^S]\right]$, and therefore the possibility of reoptimizing, is a key feature of dynamic programming models that distinguishes them from other dynamic models. In the current period, with future realizations unknown, the best the individual can do is to estimate the expected value of the best choice in the next period—i.e., the expected value of the maximum. Logically, this will also be true in the next period, and the one after it, and so forth, so the model is forward-looking and rationally handles future uncertainty. Moreover, the model presumes that the individual can reoptimize in each future period, depending on the state and shocks realized in that period. Thus, today's decision takes into account the possibility of future career changes and assumes that future decisions will also be optimizing.

The nonstochastic value of the reserve choice, V_t^R, can be written as

$$V_t^R = \gamma_r + W_t^c + W_t^r + \beta E \max[V_{t+1}^R + \omega_r, V_{t+1}^C + \omega_c],$$

while the nonstochastic value of civilian choice is

$$V_t^C = W_t^c + R_t + \beta E \max[V_{t+1}^R + \omega_r, V_{t+1}^C + \omega_c],$$

where R_t in the civilian equation is the present value of any active or reserve military retirement benefit for which the individual is eligible.

The model also incorporates three switching costs. These costs are not actually paid by the individual but are implicit in making certain transitions. The first reflects the cost of leaving active duty before ADSC is completed. The second reflects the cost of participating in reserve service before one's total service obligation is completed. These are implicit costs to the individual of not fulfilling an obligation of service. The third reflects the cost of obtaining a reserve position after being a civilian, which may be seen as representing the difficulty in finding an available reserve position for which the member is qualified in the desired geographic location, particularly when not transitioning directly from active duty.

The individual recognizes that today's choice affects military and civilian compensation in future periods. Although the individual does not know when future military promotions will occur, he or she does know the promotion policy and can form an expectation of military pay in future periods. Similarly, the individual can form expectations of future civilian pay.

Extending the DRM to Include ARP

Over the period covered by our data, Air Force pilots were eligible for multi-year contracts under which they would be paid an ARP retention bonus that typically increased with the length of the service commitment that the individual elected. As mentioned earlier, the availability of contracts and the rules governing eligibility for these multi-year contracts varied over time. Consequently, our model incorporates ARP choice into both the estimation computer code and into the simulation code.

Following Mattock and Arkes (2007), we extend the DRM to include the ARP choice by adding equations that express the value of the ARP program for different obligation lengths. The DRM described above involves two equations; the first is the value of staying active, while the second is the value of leaving, which is a nest of the reserve and civilian choice. Because our focus here is on the multi-year choice while a member is on active duty, we will ignore the reserve/civilian nest aspect of the model and describe the value of leaving at time *t* as simply V_t^L.

The equation V_t^S gives the value of staying active for one additional year, at time *t*. Thus, we can write the value of staying active for one more year as

$$V_t^{S/1} = V_t^{A/1} + \varepsilon_t^A = \gamma_a + W_t^a + \beta E \max[V_{t+1}^L, V_{t+1}^S] + \varepsilon_t^{A/1},$$

where W_t^a includes AP.

We can write the value of staying active and taking the ARP with a three-year obligation as

$$V_t^{S/3} = V_t^{A/3} + \varepsilon_t^{A/3} = \sum\nolimits_{n=0}^{2} \beta^n \left[\gamma_a + W_t^{a/3}\right] + \beta^3 E \max[V_{t+3}^L, V_{t+3}^S] + \varepsilon_t^{A/3},$$

where $W_t^{a/3}$ includes ARP for the three-year contract and AP.

Similarly, we can write the value of staying active and taking ARP with a *k*-year obligation as

$$V_t^{S/k} = V_t^{A/k} + \varepsilon_t^{A/k} = \sum {}_{n=0}^{k-1} \beta^n \left[\gamma_a + W_t^{a/k} \right] + \beta^k E \max[V_{t+k}^L, V_{t+k}^S] + \varepsilon_t^{A/k}.$$

An eligible pilot compares the value of leaving V_t^L with the maximum of the value of staying for one year, $V_t^{S/1}$, three years, $V_t^{S/3}$, five years, $V_t^{S/5}$, or *k* years, where *k* could be ten or more years in the case of an until-20-YAS option. If the three-year, five-year, and until-20-YAS options are offered, the probability that an initially offered pilot stays active is

$$PR\left(\max[V_t^{S/1}, V_t^{S/3}, V_t^{S/5}, V_t^{S/20YAS}] > V^L\right).$$

Like the reserve/civilian choice, the contract length choice can be handled as a nested choice. If we assume that the random shocks of the contract length choice follow an extreme value distribution, then we can write $\varepsilon_t^{A/k} \sim EV[-\phi\lambda_2, \lambda_2]$ where λ_2 is the shape parameter and is subscripted with a 2 to distinguish it from the shape parameter associated with the within-reserve/civilian nest shock, defined above, which we will now denote as λ_1—e.g., $\omega_t^R \sim EV[-\phi\lambda_1, \lambda_1]$. Thus, the ARP choice adds an additional parameter to be estimated. In the model without the contract length choice nest, the scale of the error in the value function for leaving was $\kappa = \sqrt{\lambda^2 + \tau^2}$, which we now relabel as $\kappa = \sqrt{\lambda_1^2 + \tau_1^2}$. By similar logic, the scale in the value function for staying with the contract length choice nest may be written $\sqrt{\lambda_2^2 + \tau_2^2}$. Imposing the requirement that the scales be equal, we have $\kappa = \sqrt{\lambda_2^2 + \tau_2^2}$. When estimating the model, we estimate κ, λ_1, and λ_2 and treat τ_1 and τ_2 as slack.

Like the reserve/civilian choice, members may have to option to make multiple contract choices over their career. For example, they might choose a one-year contract at first, then choose a five-year contract, and then follow that with a three-year contract before leaving. Because our data do not indicate which contract choice pilots made or the sequence of contract choices, we instead calculated the probability of observing a pilot staying a particular number of years and then leaving or being censored (i.e., the data end before the pilot leaves) by summing up all possible sequences of contract decisions for the purposes of constructing the likelihood function. The method we used to compute the probability of all possible paths follows the logic in Mattock and Arkes (2007). As discussed in that paper, most paths have a near-zero probability. We exploited this fact in our calculations by noting that if one term of a product of probabilities is zero, the entire expression is zero. This saves us from having to explicitly calculate the other terms in the cumulative probability expression.

Introducing an Expected Civilian Pay Variable

It would be ideal if we had data on an ex-military pilot's civilian occupation and earnings, and in particular whether the occupation was non-pilot or pilot. We could then extend the DRM choice set to include these as separate choice alternatives and, further, allow movement between these occupations, as well as participation in the reserves, by year. However, our data indicate only active component (AC) service and, after AC, reserve component (RC) participation; the data do not identify the civilian occupation or the civilian wage. Therefore, we cannot estimate a DRM involving the choice of pilot or non-pilot occupations but only the choice of

a civilian alternative that encompasses pilot and non-pilot occupations, and we must adapt the civilian pay variable to these constraints.

Chapter Four concluded that non-pilot civilian pay could be based on the 60th percentile of the age-earnings curve for full-time, full-year non-pilots; that pilot civilian pay could be based on the 80th percentile of the age-earnings curve for pilots; and that expected civilian earnings could be represented by non-pilot earnings plus the difference between pilot and non-pilot earnings multiplied by the probability of being hired by a large airline. Here, we adapt that insight by writing the expected civilian pay in year ℓ when leaving the AC in that year as

$$W_{\ell}^{c} = W_{\ell}^{non-pilot} + p_{\ell}\left(PDV_{\ell}^{pilot} - PDV_{\ell}^{non-pilot}\right),$$

where p_{ℓ} is the probability in year ℓ of being hired by a large airline. In this formulation, the individual perceives the entire expected career earnings gain from being a pilot versus a non-pilot as a one-time lump sum available in year ℓ. The civilian wage in future periods, given that the individual has left the AC, is $W_{j}^{non-pilot}$ for $j > \ell$.[3]

Estimating the Model

We estimated the 14 model parameters that underlie the decision process and described the decisionmaking population. They are as follows:

- The means and standard deviations of the tastes for active and reserve service relative to civilian opportunities—specifically, the mean active taste, mean reserve taste, and standard deviation of each taste, as well as the correlation between the taste for active and reserve service (e.g., μ_a, μ_r, σ_a, σ_r, and ρ). We assumed a bivariate normal distribution for active and reserve tastes.
- A scale parameter reflecting the dispersion of the shock affecting the reserve and civilian states individually (λ_1). We assumed an extreme value distribution for the shock.
- A scale parameter reflecting the dispersion of the shock affecting each different contract commitment length (λ_2). We assumed an extreme value distribution for the shock.
- A scale parameter reflecting total shock, including the shock of the between-nest and within-nest choices ($\kappa = \sqrt{\lambda_1^2 + \tau_1^2} = \sqrt{\lambda_2^2 + \tau_2^2}$). Because of the nesting structure of the model, this total shock is extreme value distributed.
- A switching cost that is incurred if the individual leaves active duty before completing ADSC that is a linear function of the number of years that the individual has remaining in ADSC
- A switching cost that is incurred if the individual leaves active and reserve duty before serving a combined total service obligation that is a linear function of the number of years that the individual has remaining in ADSC
- A switching cost that is incurred if the individual moves from being a civilian to being in the reserves

[3] To derive this formulation, we use the fact that, in general, $W_{j}^{c} = W_{j}^{non-pilot} + p_{t}\left(W_{j}^{pilot} - W_{j}^{non-pilot}\right)$ for periods $j \geq \ell$, or $w_j + \Delta_j$ for short.

- A switching cost that is incurred if the individual moves from being in the AC to being in the reserves
- The parameters of a logistic function for the probability of an Air Force pilot being hired by a major airline, with FAPA major airline hires per year being the explanatory variable in the function $p(x) = e^{a+bx} / \left(1 + e^{a+bx}\right)$.

To estimate the model, we used its mathematical structure, together with our assumptions about the distributions of tastes across members and about the shocks to derive expressions for the transition probabilities, given one's state. The transition probability is the probability of choosing a particular alternative—active, reserve, or pure civilian—given one's current state and the fact that one is free to make a choice. Because of our assumption of an extreme value distribution for the shocks, we were able to derive closed-form logistic expressions for each transition probability. For example, the probability of choosing to stay active at time *t*, given that the member is already in the AC and is eligible to stay one year or choose a three-year or five-year ARP contract, is given by

$$\Pr(V^A > V^L) = \frac{\left[e^{\frac{V^{A/1}}{\lambda_2}} + e^{\frac{V^{A/3}}{\lambda_2}} + e^{\frac{V^{A/5}}{\lambda_2}} \right]^{\frac{\lambda_2}{\kappa}}}{\left[e^{\frac{V^{A/1}}{\lambda_2}} + e^{\frac{V^{A/3}}{\lambda_2}} + e^{\frac{V^{A/5}}{\lambda_2}} \right]^{\frac{\lambda_2}{\kappa}} + \left[e^{\frac{V^{R}}{\lambda_1}} + e^{\frac{V^{C}}{\lambda_1}} \right]^{\frac{\lambda_1}{\kappa}}},$$

where we omit the subscript *t* for clarity.

Because the transition probabilities in different periods are independent of one another when an individual is free to make a choice (by assumption)—the model is a Markov decision process—the transition probabilities for each period can be multiplied to obtain the probability of any given career profile of active, reserve, and pure civilian alternatives that we observe in the data. Multiplying the career profile probabilities together gives an expression for the sample likelihood that we used to estimate the model parameters for each occupation using maximum likelihood methods. Optimization is done using the BFGS (Broyden-Fletcher-Goldfarb-Shanno) algorithm, a standard hill-climbing method. Standard errors of the estimates were computed using numerical differentiation of the likelihood function and taking the square root of the absolute value of the diagonal of the inverse of the Hessian matrix. To judge goodness of fit, we used the parameter estimates to simulate retention rates by year of service of personnel and compared those rates to the actual data. We show goodness-of-fit diagrams in the next section, where we present the models' parameter estimates.

Our main file for analysis was the Work Experience (WEX) file. These data contain person-specific longitudinal records of active and reserve service. The WEX data begin with service members in the AC or RC on or after September 30, 1990. Our analysis file includes AC entrants in 1990–2000—i.e., the 1990–2000 cohorts of officers, followed through 2012, providing 23 years of data for the 1990 cohort and 13 years of data for the 2000 cohort. We estimated the DRM for the entering 1990–2000 cohorts of Air Force pilots.

Once we had parameter estimates, we could then use the logic of the model and the estimated parameters to simulate the active component cumulative probability of retention in each

year of service in the steady state for a given policy environment, such as an increase in ARP, a change in the level of AP, or an increase in the civilian opportunity wage facing Air Force pilots. By *steady state*, we mean when the force consists solely of members who have spent their entire careers under the policy environment being considered. The simulation output includes a graph of the AC retention profile by years of service. We can also produce graphs of RC participation and provide computations of costs, though we do not do so here. We show model fits in the next section by simulating the steady retention profile in the baseline—or current policy environment—and comparing the simulation to the retention profile observed in the data.

Parameter Estimates and Model Fit

We estimated the model assuming a discount factor of 0.94, based on previous estimates produced using models of officer behavior for all services (e.g. Mattock, Hosek, and Asch, 2012). All the parameters are estimated in logs, with the exception of the correlation parameter ρ, which is estimated as the inverse hyperbolic tangent, and the intercept and slope of the probability of hiring, which are coefficients in a logit function of major airline hiring, as reported by FAPA $\left[e^{a+bx}/\left(1+e^{a+bx}\right)\right]$. The parameter estimates, estimated standard errors, and z statistics are shown in Table 6.1.a. All estimates are statistically significant. We transformed the estimated parameters to recover the values of the parameters in the theoretical model. These are shown in in Table 6.1.b.

All coefficients have the expected sign, with the exception of the mean of active taste, which is positive and significant. The switching costs are large, as expected, and the correlation between taste for active service and reserve service is in the range that we have observed among other samples of military personnel in previous work.

The model fits the data well through active retirement vesting at 20 YOS, as can be seen in Figures 6.1 through 6.3. The first figure shows predicted active retention for the sample of cohorts from 1990 through 2000 compared to a Kaplan-Meier empirical survival curve for the observed data in the same sample. The Kaplan-Meier confidence intervals are shown as dashed lines. In the years before active retirement vesting, the model prediction falls within the confidence intervals for all but one YOS, while in the years after active retirement vesting, the model overpredicts retention for the members of the first two cohorts. This may be because these were larger cohorts relative to the other cohorts in this time period, and the members of these cohorts may have had lower active career opportunities relative to other, smaller cohorts in the wake of the Air Force drawdown in the early 1990s.

Figure 6.2 shows predicted and observed total AC and RC years of service of the members of the sample who participated in the RC at any time after their AC service. The data are rendered as a survival curve so that we can compare the model prediction with the empirical survival curve for the data. The fit is good through YOS 16, and though it falls outside the confidence intervals in most of the remaining years, the model prediction does not deviate far from the observed data.

Figure 6.3 shows reserve participation by total AC and RC years of service as a histogram. Note that this figure shows RC participation among those who have prior AC service only, and so it may look different from similar graphs that group the RC members who entered with prior active service and the RC members who entered without prior active service together. The fit characteristics are analogous to those in Figure 5.2; the fit is very good through YOS 16 but shows some deviation in later YOS.

Table 6.1.a
Parameter Estimates for Air Force Pilots

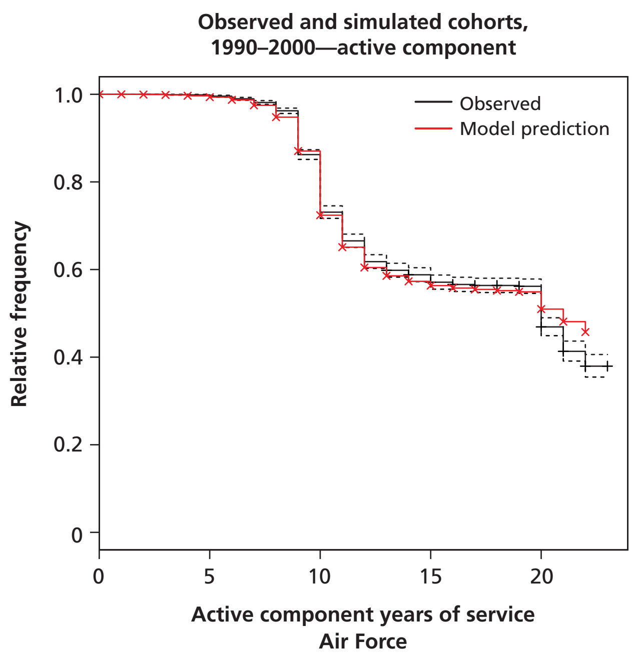
	Parameter Estimate	Standard Error	*Z* Statistic
ln(Kappa)	5.9772	0.0246	243.1466
ln(Lambda1)	5.0996	0.0507	100.5622
ln(Lambda2)	2.9889	0.1716	17.4158
–1*ln(Mu1)	–2.9739	5.8195	–0.5110
–1*ln(Mu2)	2.5813	0.3526	7.3210
ln(SD11)	–2.7899	13.0779	–0.2133
ln(SD22)	4.7951	0.0826	58.0327
atanh(Rho)	0.6478	0.0608	10.6557
–1*ln(Switch1)	5.6795	0.0518	109.6384
–1*ln(Switch2)	6.4362	0.0487	132.1968
–1*ln(Switch3)	6.5781	0.0556	118.3838
–1*ln(Switch4)	6.2297	0.0550	113.3202
FAPA major airline hiring intercept	–4.4269	0.8646	–5.1203
FAPA major airline hiring slope	1.3678	0.3054	4.4787

NOTES: atanh = correlation of active and reserve taste; SD11 = standard deviation of active taste; SD22 = standard deviation of reserve taste.

Table 6.1.b
Transformed Parameter Estimates for Air Force Pilots

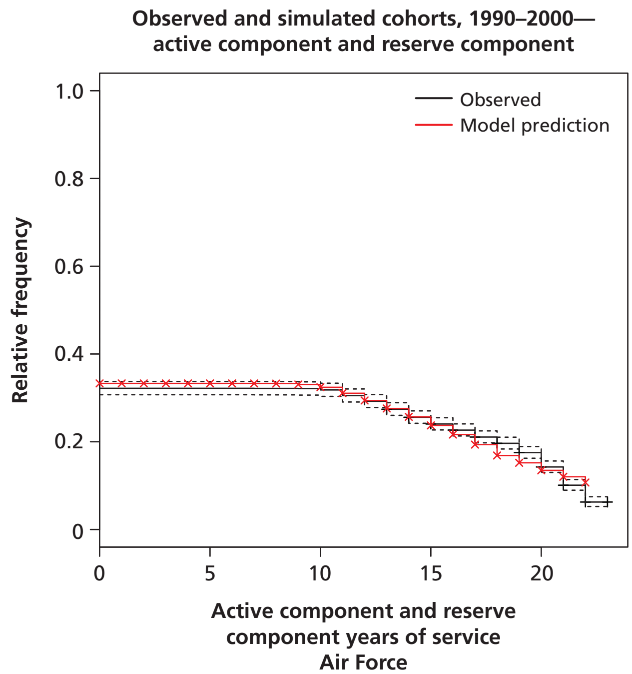
	Transformed Parameter Estimate
Shape Parameter, Nest (Kappa)	394.3260
Shape Parameter, Alternatives Within Nest (Lambda1)	163.9570
Shape Parameter, ARP Alternatives Within Nest (Lambda2)	19.8644
Mean Active Taste (Mu1)	–0.0511
Mean Reserve Taste (Mu2)	–13.2141
Standard Deviation of Active Taste (SD11)	0.0614
Standard Deviation of Reserve Taste (SD22)	120.9152
Correlation of Active and Reserve Taste (Rho)	0.5702
Switch Cost 1	–292.8133
Switch Cost 2	–624.0230
Switch Cost 3	–719.1552
Switch Cost 4	–507.5864
FAPA major airline hiring intercept	–4.4269
FAPA major airline hiring slope	1.3678

Figure 6.1
Predicted and Observed Active Retention



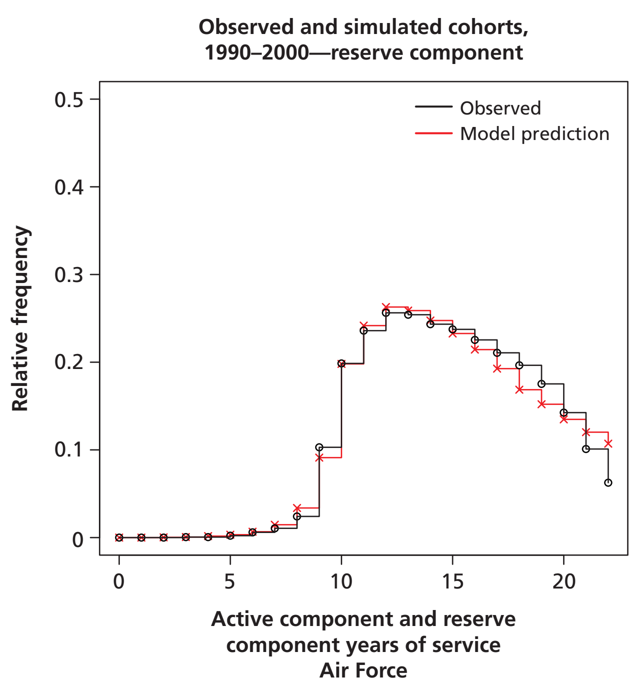
RAND *RR1455-6.1*

Figure 6.2
Predicted and Observed Total Active Retention Plus Reserve Participation



RAND *RR1455-6.2*

Figure 6.3
Predicted and Observed Reserve Participation, by Combined Active and Reserve Years of Service



RAND *RR1455-6.3*

CHAPTER SEVEN

Simulations Results

The analysis of civilian demand for pilots in Chapter Five suggests that a steady increase in hiring will occur in the future because of growth in mandatory retirements and growth in air transportation. However, this increase may be mitigated by increases in aircraft size, load factor, and stage length. In Chapter Four, we approximated the real increases in pilot and non-pilot pay from 2014 to 2018 as 17 percent and 8 percent, respectively. We also provided an expression for the expected present value of civilian earnings that incorporates pilot and non-pilot civilian earnings, as well as the probability that a military pilot will be hired by a major airline. Thus, changes in Air Force pilot civilian opportunities can occur in our analysis because of changes in external pilot and non-pilot earnings and the probability being hired as a pilot.

In this chapter, we simulate the impacts of increased major airline hiring and pay over a range of values. Although we did not forecast specific values for hiring and pay increases, simulating over a range can provide information about the range of effects on pilot retention and assist in preparing for particular but currently unknown hiring and pay conditions. We also simulate the effect of increases in ARP to quantify the relationship between ARP offers and retention response. Because foresight is not perfect and because it takes time to grow trained pilots, it would be wise for the Air Force to have the capability to respond quickly to sustain pilot retention in the face of changes in the external opportunities for pilots.

Developing the capability to respond quickly requires information on the extent to which a change in civilian opportunities will affect pilot retention and information on the extent to which special and incentive pays for pilots must change to sustain their retention. The DRM provides such a capability. The model, the estimates, and the simulation capability were described in the previous chapter. Here, we present simulation results.

We first show the effect on pilot retention of an increase in the probability of being hired by a major airline from a baseline of 10 percent to 40 percent. The 10-percent baseline corresponds to approximately 1,700 hires per year and is also the average hiring probability between 2003 and 2013, as estimated by the DRM. The 40-percent figure corresponds to about 2,900 hires by major airlines per year, which is close to the 3,053 major airline hires in 2014 reported by FAPA. We also considered an increase to the probability of being hired by a major airline of 50 percent, which corresponds to approximately 3,200 hires per year, slightly below the average reported by FAPA for 2014 through 2015.

Next, we simulated the effect on pilot retention of a 17-percent real increase in civilian pilot pay above the 2014 level, in addition to the increase in the probability of being hired by a major airline, as well as an 8-percent real increase in civilian non-pilot pay above its 2014 level. In our model, all civilian pay increases need to be considered relative to expected growth

in military pay, or regular military compensation (RMC). For example, if military pay is expected to grow by 4 percent (real) from 2014 to 2018, non-pilot pay by 8 percent (real), and pilot pay by 17 percent (real) over the same period, then the relative increases we simulate in our model are a 4-percent net increase in non-pilot pay and a 13-percent net increase in pilot pay. More generally, if the real growth in RMC is x percent, then the net increase in non-pilot pay is $8 - x$ percent, and the net increase in pilot pay is $17 - x$ percent. The first four columns of Table 7.1 show a selected subset of the range of scenarios we considered in terms of changes in the probability of being hired and the percentage change in net civilian pilot and non-pilot earnings. The full range of scenarios we considered is shown in Table D.1 in Appendix D.

We then provide an estimate of how much ARP must increase to sustain retention in the face of a 4-percent net increase in non-pilot pay, a 13-percent net increase in civilian pilot pay, and an increase in the probability of being hired by an airline to 60 percent (or to 3,500 hires). We also extended this analysis to consider the required ARP increase in response to a range of external wage increases and probabilities of being hired. The full range of scenarios we considered when determining the necessary ARP increase is shown in Table D.2 in Appendix D, and these scenarios parallel those in Table D.1.

Finally, we present simulation results of a policy that would eliminate flight pay (AP) for pilots in non-flying positions. This analysis illustrates not only the retention effects of changes in flight pay but also how the DRM capability can be used to assess the retention effects of pilot-related special and incentive (S&I) pays other than ARP.

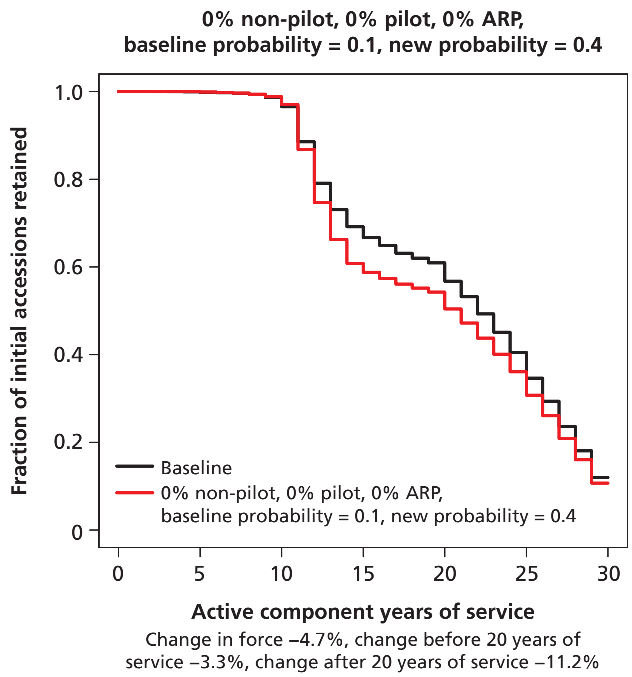
Retention Effects of Increases in Expected Civilian Pilot Opportunities

Figure 7.1 shows the simulated steady-state retention effect of an increase in the probability of being hired by a major airline from 10 percent to 40 percent (or an increase in hiring from about 1,700 per year to 2,900 per year).[1] An increase in the probability of being hired by a major airline increases expected civilian pilot opportunities, even if civilian pilot and non-pilot earnings are unchanged. For these simulations, we assumed that three-year, five-year, and until-20-YAS contracts were offered both to initially eligible officers and to officers beyond their initial eligibility, as well as after active retirement vesting, in the case of the three- and five-year contracts. This approach extends the ability to model ARP and detect its effect over all years of service after ADSC. By comparison, the studies reviewed in Chapter Two focused exclusively on retention at the end of ADSC and did not model the pilot's choice over ARP contract length. We also assumed that an officer may elect to take up to 50 percent of the stream of payments under a given contract as a lump sum up front, with the remainder paid out over the remaining years of the contract. This set of assumptions will tend to dampen the effect of a civilian pay increase on retention; we will relax one of these assumptions later in this section.

The figure shows that pilot retention drops among midcareer and senior career personnel—i.e., among personnel who have completed their active-duty service commitment. Overall force size drops by 4.7 percent. Thus, an increase in external civilian opportunities as a result of an

1 By *steady state*, we mean the long-term effects when all Air Force pilots have spent their entire career making retention decisions under the condition of a higher probability of being hired of 40 percent. Given a career length of 30 years, it takes 30 years for the steady state to be achieved.

Figure 7.1
Simulated Steady-State Effect on USAF Pilot Retention of an Increase in the Probability of Being Hired by a Major Airline from 10 Percent to 40 Percent (an Increase from 1,700 to 2,900 Hires per Year)



RAND *RR1455-7.1*

increase in major airline hiring to 2,900 (slightly less than the actual hiring of 3,053 in 2014, as reported by FAPA) would reduce USAF pilot force size by 4.7 percent in the long run, holding accessions constant. This decrease of 4.7 percent would correspond to an overall decline in Air Force pilot end strength of over 600 personnel.[2]

Figure 7.2 shows the simulated steady-state retention effect of an increase in the probability of being hired by a major airline from 10 percent to 50 percent (or an increase in hiring from about 1,700 per year to 3,200 per year, which is slightly below the average of major airline hiring in 2014 through 2015, as reported by FAPA).[3] Force size drops by 6.3 percent, corresponding to an overall decline in Air Force pilot end strength of 787 personnel.

As mentioned, civilian pilot earnings have increased and are expected to continue to increase in the near term. External non-pilot earnings are also expected to increase. Therefore, we considered the additional effects on USAF pilot retention of a 13-percent net increase in external pilot pay, on top of an increase in major airline hiring from 1,700 to 3,200 (representing an increase in the probability of being hired from 10 percent to 50 percent), combined with a 4-percent net increase in non-pilot pay. As mentioned earlier, these are the net increases corresponding to a 4-percent real increase in RMC, a 17-percent real increase in civilian pilot

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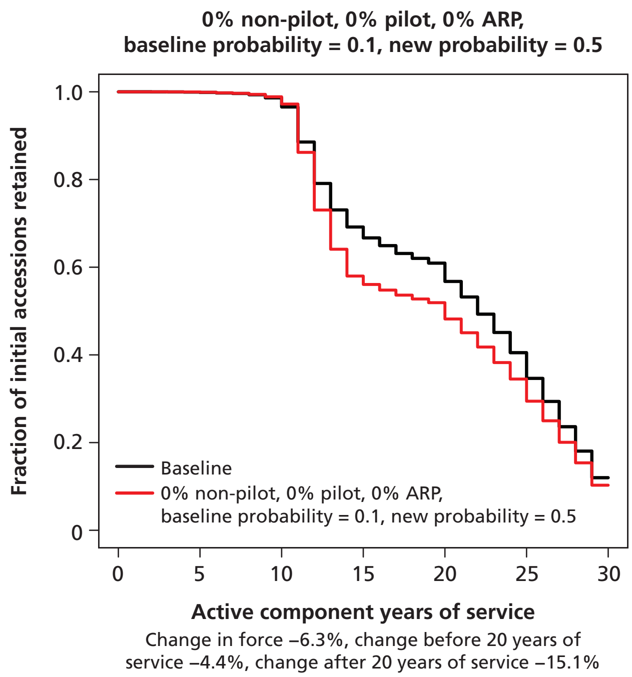
2 As of September 30, 2015, there were 12,496 pilots in the grade of lieutenant colonel and below, according to AFPC (Air Force Personnel Center, 2016).

3 Major airline hiring was 3,053 in 2014 and 3,429 in 2015 (FAPA, undated).

Figure 7.2
Simulated Steady-State Effect on USAF Pilot Retention of an Increase in the Probability of Being Hired by a Major Airline from 10 Percent to 50 Percent (an Increase from 1,700 to 3,200 Hires per Year)



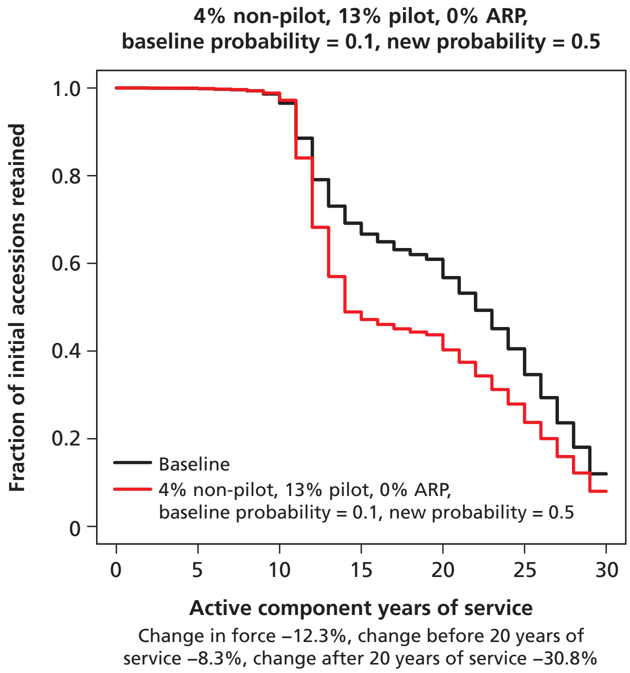
RAND *RR1455-7.2*

pay, and an 8-percent real increase in external non-pilot earnings. The results are shown in Figure 7.3. We found that a real increase in civilian pilot pay on top of increased major airline hiring would have a more negative retention effect than what we show in Figures 7.1 and 7.2. The drop in midcareer and senior career retention is larger, and overall, the pilot force drops by 12.3 percent (or over 1,500 personnel at current pilot strength levels) in the steady state, holding accessions constant.

We also considered other scenarios that increase the civilian earnings opportunities of USAF pilots, given uncertainty about future values of pilot pay, non-pilot pay, the probability of a USAF pilot being hired by a major airline, and RMC. Table 7.1 shows the simulated effects of a range of net civilian pilot pay increases (from 9 to 14 percent) on pilot force size for a range of increases in the probability of being hired by a major airline (from 40 percent [2,900 hires] to 70 percent [3,800 hires]) relative to a baseline of 10 percent (1,700 hires per year). These correspond to cases in which there is a 17-percent real increase in civilian pilot pay and an 8-percent real increase in civilian non-pilot pay relative to 2014 levels, along with a real increase in RMC ranging from 3 to 8 percent. The table shows the change in force size overall, as well as the size of the force with fewer and with more than 20 YOS (i.e., pre- and post-retirement vesting).

Table 7.1 shows that either changes in major airline hiring or changes in civilian pilot earnings can have substantial negative effects on USAF pilot retention. For example, if non-pilot pay increases by 0 percent and pilot pay increases by 9 percent, then increasing the probability of being hired to 40 reduces the force size by 6.9 percent (890 personnel), but increasing

Figure 7.3
Simulated Steady-State Effect on USAF Pilot Retention of a 13-Percent Net Increase in External Pilot Earnings and a 4-Percent Net Increase in Non-Pilot Earnings, Given an Increase in the Probability of Being Hired by a Major Airline from 10 Percent to 50 Percent (an Increase from 1,700 to 3,200 Hires per Year)



RAND *RR1455-7.3*

the probability to 50 percent reduces the force size even more, by 9.8 percent (1,264 personnel), holding accessions constant. Similarly, if hiring probability is held constant at 40 percent, increasing both non-pilot and civilian pilot pay by 5 percentage points (to 5 percent and 14 percent, respectively) would yield a similar negative effect on retention (10.1 percent, or 1,303 personnel).

While we show some entries in Table 7.1 where RMC maintains parity with civilian non-pilot pay, we expect military pay to grow by less than 8 percent from 2014 to 2018. In FY 2014 the increase in basic pay was 1.0 percent, compared with a 1.8-percent increase in the Employment Cost Index (ECI), and in FY 2015 the increase in basic pay was 1.3, compared with a 2.3-percent increase in ECI. However, basic pay is only one element of RMC, with the basic allowance for housing, the basic allowance for subsistence, and the tax advantage comprising the remainder. In 2016, the basic allowance for housing (BAH) increased by an average of 3.4 percent, but the member cost-sharing element for housing also increased to 2 percent and is planned to increase to 5 percent over the next three years. As mentioned earlier, for the year ending December 2014, inflation as measured by the CPI-U was 0.76 percent, and for the year ending December 2015 it was 0.73 percent, resulting in a cumulative inflation rate of 1.5 percent. Together, this results in a real increase of less than 1 percent in RMC from 2014 through the beginning of 2016. For example, RMC for an average O-4 at 11 YOS was $116,258.37 in

Table 7.1
Simulated Percentage Change in Steady-State Force Size Caused by an Increase in the Probability of Being Hired by a Major Airline and/or an Increase in Civilian Opportunity Earnings (Three-Year, Five-Year, and Until-20-YAS Contracts)

Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Overall Force Size	Change in Overall Force Size (Number of Personnel)	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS
2,900	40%	0%	9%	–6.9%	890	–4.9%	–16.4%
2,900	40%	1%	10%	–7.5%	968	–5.2%	–18.2%
2,900	40%	2%	11%	–8.1%	1,045	–5.6%	–19.7%
2,900	40%	3%	12%	–8.8%	1,135	–5.9%	–22.0%
2,900	40%	4%	13%	–9.6%	1,238	–6.4%	–24.3%
2,900	40%	5%	14%	–10.1%	1,303	–6.7%	–26.0%
3,200	50%	0%	9%	–9.8%	1,264	–6.8%	–23.4%
3,200	50%	1%	10%	–10.3%	1,329	–7.1%	–25.0%
3,200	50%	2%	11%	–11.0%	1,419	–7.5%	–27.0%
3,200	50%	3%	12%	–11.7%	1,509	–7.9%	–29.1%
3,200	50%	4%	13%	–12.3%	1,587	–8.3%	–30.8%
3,200	50%	5%	14%	–12.9%	1,664	–8.6%	–32.5%
3,500	60%	0%	9%	–12.4%	1,600	–8.6%	–29.8%
3,500	60%	1%	10%	–13.0%	1,677	–9.0%	–31.5%
3,500	60%	2%	11%	–13.7%	1,767	–9.4%	–33.6%
3,500	60%	3%	12%	–14.4%	1,858	–9.8%	–35.6%
3,500	60%	4%	13%	–15.0%	1,935	–10.2%	–37.4%
3,500	60%	5%	14%	–15.6%	2,012	–10.5%	–39.0%
3,800	70%	0%	9%	–15.1%	1,948	–10.5%	–36.4%
3,800	70%	1%	10%	–15.8%	2,038	–10.9%	–38.2%
3,800	70%	2%	11%	–16.4%	2,116	–11.3%	–40.0%
3,800	70%	3%	12%	–17.1%	2,206	–11.7%	–42.1%
3,800	70%	4%	13%	–17.7%	2,283	–12.1%	–43.7%
3,800	70%	5%	14%	–18.3%	2,361	–12.4%	–45.3%

2014, increasing to $118,458.04 in 2016, which is a 1.9-percent increase. When the 1.5-percent rate of inflation is subtracted, this leaves a real increase of only 0.4 percent. However, it may be unlikely that this low real rate of increase in RMC will be maintained for long; RMC may grow through either higher basic pay increases, a reversal of the BAH cost-sharing policy, or both, and our scenarios encompass different assumptions about RMC growth.

Using Aviator Retention Pay to Offset Negative Retention Effects of Increases in Expected Civilian Pilot Opportunities

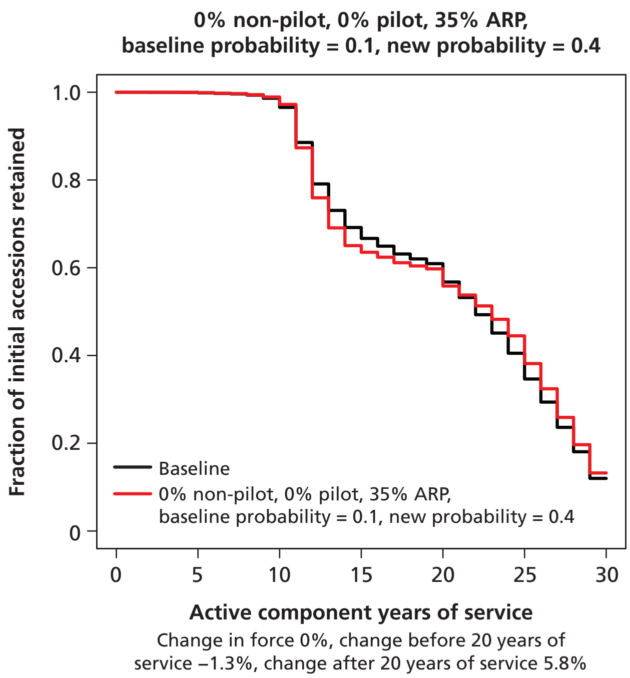
As discussed in Chapter Six, the Air Force uses ARP in conjunction with flight pay (AP) to sustain retention to meet requirements. Insofar as the baseline in Figures 7.1 through 7.3 reflects requirements, increases in expected civilian pilot opportunities will result in pilot retention falling short of requirements, as shown by the red lines in the figures. The question, then, is how much does ARP need to increase to offset the negative retention effect?

We can address this question using the DRM. Specifically, the DRM simulation capability includes an optimization routine that finds the amount of ARP that minimizes the gap between the red line in the figures (the retention profile produced by the increase in expected civilian opportunities) and the black line (the baseline). We performed this optimization for the case in which the likelihood of being hired by a major airline increases and civilian pilot pay also increases. We explored different scenarios, defined by the first four columns of Table 7.1 (and by Table 7.2). These correspond to cases in which the probability of being hired by a major airline increases by a range of 40 percent to 70 percent, together with a 17-percent real increase in civilian pilot pay and an 8-percent real increase in civilian non-pilot pay relative to 2014 levels, along with a real increase in RMC ranging from 3 to 8 percent.

Figure 7.4 adapts Figure 7.1 by incorporating the effect on pilot retention when ARP is increased to compensate for the negative effects on retention of an increase in major airline hiring from 10 percent (baseline) to 40 percent (and assuming no change in civilian pilot pay). As shown in Figure 7.1, the increase in hiring reduces midcareer retention and reduces overall force size by 4.7 percent, holding accessions constant. In Figure 7.4, we find that a 35-percent increase in ARP would be required to offset the increase in major airline hiring. A 35-percent increase would increase ARP from $25,000 per year—the current maximum allowable payment—to $33,750 per year.

The increase in ARP produces an increase in pilot retention that offsets the drop that occurs when civilian opportunities expand. Overall pilot force size is unchanged with an increase in ARP of 35 percent. But we do find a change in experience mix, with 1.3 percent fewer personnel with less than 20 years of service and 5.8 percent more personnel serving with more than 20 years of service. That is, the pilot force becomes more senior. This is because of the increased value of ARP contracts that go beyond retirement vesting up to 25 YOS, as well as selectivity induced by the nature of the ARP offer, although the selection effect is likely to be small because of the small estimated active taste variance. A pilot can secure a higher amount of ARP only by signing up for more years of service, and pilots with a higher taste for military service are the ones more likely to do this. Thus, the taste distribution conditional on reaching 20 years of service will tend to have relatively more pilots with a higher taste for military service, as compared with this distribution in the baseline pilot force. Given this change in the taste distribution, pilots will be more likely to continue the military beyond 20 years of service,

Figure 7.4
Simulated Steady-State Effect on USAF Pilot Retention of an Increase in the Probability of Being Hired by a Major Airline from 10 Percent to 40 Percent (an Increase from 1,700 to 2,900 Hires per Year) When a Compensating Increase in ARP Is Implemented

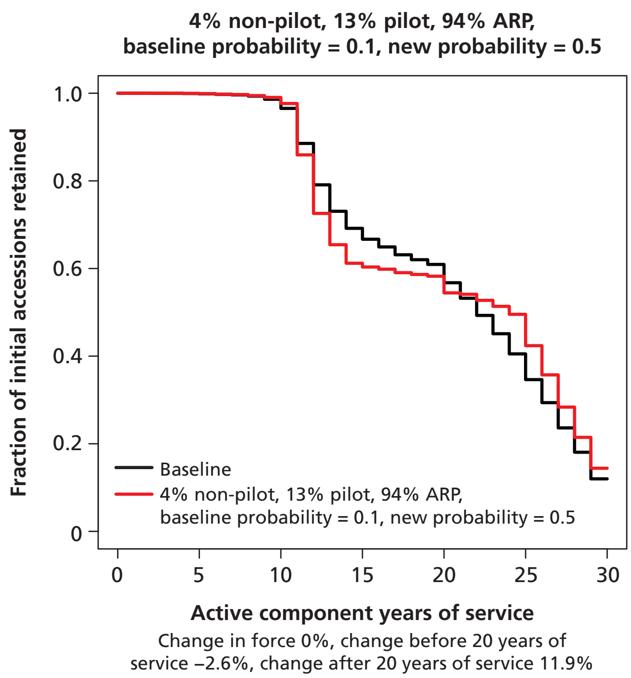


RAND *RR1455-7.4*

again as compared with the retention of those with more than 20 years of service at baseline. As a caveat, however, although the DRM assumes that continuation is at the volition of the service member, the service could in fact choose to change (tighten) its criteria for retention or to limit availability of ARP contracts for service beyond retirement vesting, in which case actual retention after 20 years of service would be less than shown in Figure 7.4. Even if those criteria were not changed, another consideration is that the number of slots for higher-rank positions is likely to be fairly constant. An increase in the retention of those with more than 20 years of service could therefore cause a slowdown in promotion speed (advancement to higher ranks), and this in turn could deter pilots from wanting to continue beyond 20 years of service. Pilots with fewer years of service—e.g., those considering taking ARP—might also foresee the possible decrease in promotion speed, but the effect of slower promotion would be discounted because it would not be felt until after 20 years of service. Although the DRM does not model possible changes in criteria for continuation or promotion speed, such changes could operate to prevent or decrease the extent of an increase in retention after 20 years of service.

Given the (approximated) planned real increase in large airline pay scales of about 17 percent and the projected real increase in civilian non-pilot earnings, as well as an assumed real increase in RMC of 4 percent, we also computed how much ARP must increase to offset the joint impact of a 13-percent net increase in civilian pilot pay, a 4-percent net increase in non-pilot pay, and an increase in major airline hiring. As shown in Figure 7.3 and Table 7.1, we found that the USAF pilot force size would drop by 15 percent. Figure 7.5 shows that to offset

Figure 7.5
Simulated Steady-State Effect of a 13-Percent Increase in Civilian Pilot Pay and 4-Percent Increase in Civilian Non-Pilot Pay Plus an Increase in the Probability of Being Hired by a Major Airline from 10 Percent to 50 Percent (an Increase from 1,700 to 3,200 Hires per Year) When a Compensating Increase in ARP Is Implemented



RAND *RR1455-7.5*

that drop, ARP would need to increase by 94 percent, or to $48,500 per year. Such an increase would sustain the overall size of the pilot force, though the experience mix would become more senior. The pilot force with fewer than 20 YOS would fall by 2.6 percent, while the force with 20 or more YOS would increase by 11.9 percent.

We considered a range of scenarios in which expected civilian opportunities improve, and we computed the increase in ARP to offset the effects of those improvements. As in Table 7.1, the range we considered corresponds to a 17-percent real increase in civilian pilot pay and an 8-percent real increase in civilian non-pilot pay relative to 2014 levels, along with a real increase in RMC ranging from 3 to 8 percent.

The first four columns of Table 7.2 show the scenarios, while the next-to-last column shows the percentage increase in ARP required to sustain the overall size of the USAF pilot force. The last column shows the estimated increase in the ARP budget needed to sustain retention, based on scaling the FY 2014 actual expenditure on ARP (approximately $64 million[4]). Even though the total force size is held unchanged, the force becomes more senior under all of the scenarios we consider, with the percentage change in the force with more than 20 YOS greater than the decrease in the percentage change in the force with fewer than 20 YOS.

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[4] Department of the Air Force, 2014.

Table 7.2
Simulated Percentage Increase in ARP Needed to Compensate for an Increase in the Civilian Pilot Wage and Hiring Probability, Holding Force Size Constant

Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS	Percentage Increase in ARP	Estimated ARP Budget Increase (in millions of 2015 dollars)
2,900	40%	0%	9%	–1.9%	8.5%	54%	35
2,900	40%	1%	10%	–1.9%	8.9%	58%	37
2,900	40%	2%	11%	–2.0%	9.5%	63%	41
2,900	40%	3%	12%	–2.0%	9.4%	67%	43
2,900	40%	4%	13%	–2.1%	9.7%	72%	46
2,900	40%	5%	14%	–2.2%	10.0%	77%	50
3,200	50%	0%	9%	–2.4%	11.2%	72%	46
3,200	50%	1%	10%	–2.5%	11.5%	78%	50
3,200	50%	2%	11%	–2.5%	11.6%	84%	54
3,200	50%	3%	12%	–2.5%	11.8%	89%	57
3,200	50%	4%	13%	–2.6%	11.9%	94%	61
3,200	50%	5%	14%	–2.6%	12.0%	100%	64
3,500	60%	0%	9%	–2.8%	13.0%	96%	62
3,500	60%	1%	10%	–2.9%	13.2%	102%	66
3,500	60%	2%	11%	–2.9%	13.3%	107%	69
3,500	60%	3%	12%	–2.9%	13.3%	113%	73
3,500	60%	4%	13%	–2.9%	13.4%	119%	77
3,500	60%	5%	14%	–2.9%	13.5%	125%	81
3,800	70%	0%	9%	–3.1%	14.2%	121%	78
3,800	70%	1%	10%	–3.1%	14.3%	127%	82
3,800	70%	2%	11%	–3.1%	14.3%	134%	86
3,800	70%	3%	12%	–3.1%	14.1%	139%	90
3,800	70%	4%	13%	–3.1%	14.2%	146%	94
3,800	70%	5%	14%	–3.1%	14.4%	151%	97

A key conclusion emerging from Table 7.2 is that the ARP cap must increase substantially to offset the range of increases in external civilian opportunities considered in the table. Specifically, across the scenarios, the percentage increases in ARP range from 54 percent to 151 percent, representing increases in ARP from its current maximum of $25,000 to a range of $38,500 to $62,500.

Of course, we could include additional scenarios with even greater increases in external pilot pay and greater airline hiring, resulting in even greater increases in ARP. In light of what

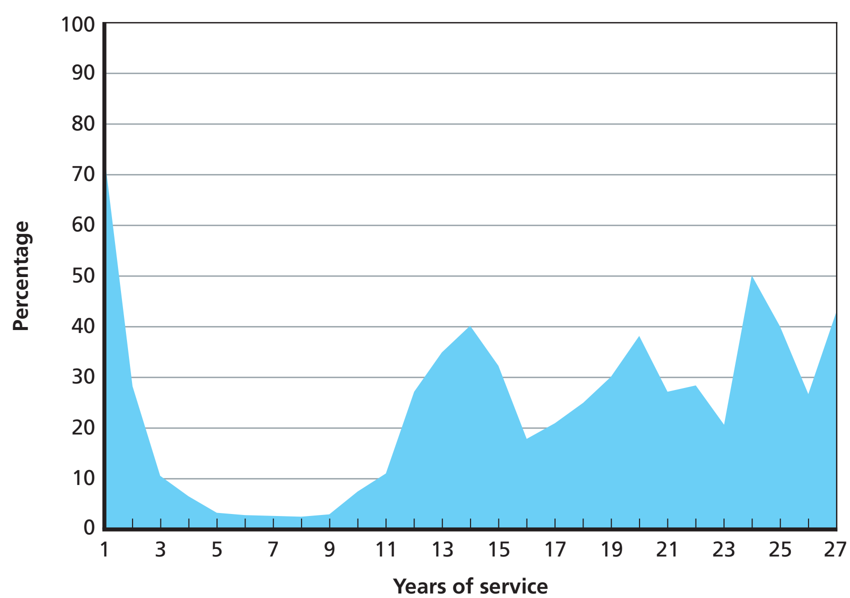
we can conclude from earlier chapters about future airline hiring and external pilot wages, the results in Table 7.2 indicate that even under the most optimistic scenario, an increase in the ARP cap of at least $13,500 is warranted.

Eliminating Aviator Pay for Non-Flying Assignments

Like ARP, AP is a special pay intended to attract and retain officers in a military aviation career. According to the *2011 Military Compensation Background Papers* (U.S. Department of Defense, 2011, p. 281), the idea of ACIP (the predecessor of AP) at its inception in 1974 was to ". . . establish a system whereby an officer involved in the 'frequent and regular performance of operational or proficiency flying duty' was entitled to continuation aviation career incentive pay independently of whether, during any given year, the officer was actually assigned to flying duty." Eligibility for AP is currently based on the amount of operational flying time within a specified period. AP is a discretionary pay, and, like other S&I pays, it can be targeted. One approach to targeting AP would be to offer it only to those actually in flying assignments. Currently, AP can be paid to pilots who are assigned to flying or non-flying positions, if they meet the eligibility criteria.

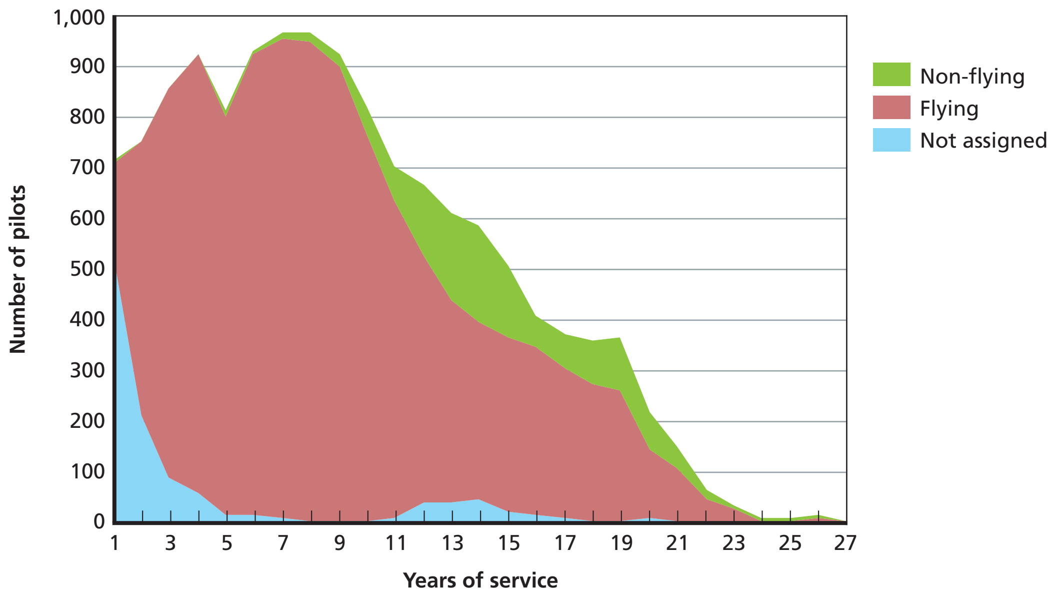
As seen in Figures 7.6 and 7.7, pilots in non-flying positions are typically midcareer or senior personnel. Figure 7.6 shows the percentage of pilots who are in flying positions, by years of service, using Air Force personnel data on officers from AFPC, extracted May 12, 2014. The number of pilots in flying versus non-flying assignments by years of service is shown in Figure 7.7. The green area in Figure 7.7 shows the number of pilots in non-flying positions. Interestingly, most pilots, even those in their mid- and senior career stages, are

Figure 7.6
Percentage of USAF Pilots Assigned to a Non-Flying Position by Years of Service, as of May 2014



RAND *RR1455-7.6*

Figure 7.7
Number of USAF Pilots by Years of Service, by Assignment Type, as of May 2014



RAND *RR1455-7.7*

in flying positions. After YOS 11, only about a quarter or more of pilots are in non-flying positions.

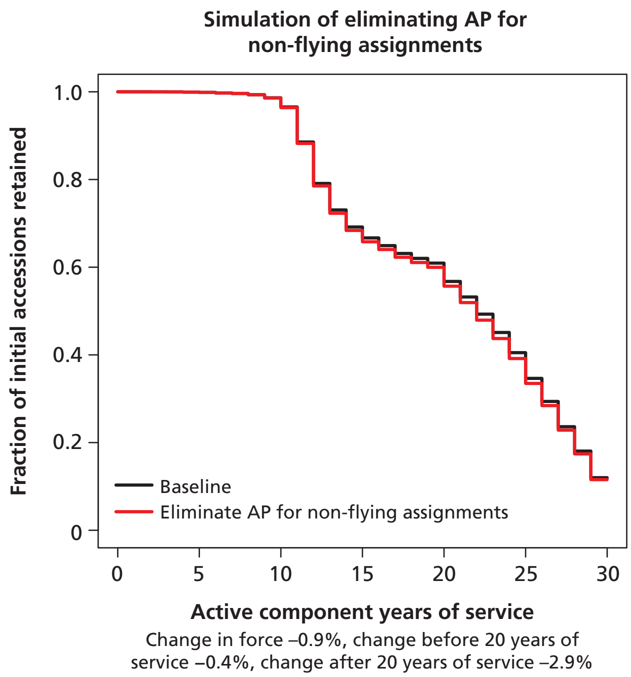
Relevant to the possibility of paying AP to only those in flying positions is the question of how pilot retention would be affected, given that AP is currently paid to those in both flying and non-flying assignments. In the DRM, a pilot contemplating whether to stay in the Air Force weighs the value of staying against the value of leaving. Such a pilot can expect to receive a lower amount of AP over his or her career if AP is only paid when pilots are in flying positions. We implemented this concept by weighting AP in each year of service by the probability of being in a flying position and receiving AP, using the probabilities by years of service shown in Figure 7.6. We then simulated how this would affect pilot retention.

The simulation results are shown in Figures 7.8, 7.9, and 7.10 for different probabilities of being hired as a pilot by a major airline. We found that reducing expected AP by eliminating it for those in non-flying positions would reduce the pilot force size by 0.9 to 1.1 percent (or 120 to 140 pilots from current end strength), depending on the likelihood of officers being hired by major airlines. The reduction is modest because, as shown in Figures 7.6 and 7.7, the majority of even midcareer and more senior pilots fill flying rather than non-flying positions. Still, the decrease in retention is largest for those with over 13 years of service. This result is robust to variation in the underlying model assumptions, as long as the eligibility rules are relatively generous (that is, they allow non-initially eligible officers to take ARP contracts).

Summary

The simulation results show that Air Force pilot retention responds to changes in the external civilian labor market as well as to changes in special pays. We considered increases in both

Figure 7.8
Simulated Steady-State Effect on USAF Pilot Retention of Elimination of AP for Non-Flying Positions When Probability of Being Hired by a Major Airline Is 0.1 (1,700 Hires per Year)



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external pay opportunities relative to the military and increases in hiring by major airlines. Specifically, we considered a range of 9- to 14-percent increases in real civilian earnings for pilots relative to RMC, as well as increases in the probability of being hired by a major airline of 10 percent (corresponding to 1,700 hires per year), 40 percent (or 2,900 hires per year), and 50 percent (or 3,200 hires per year). We found that a 13-percent net increase in civilian pilot pay and a 4-percent net increase in non-pilot pay on top of a steady-state increase in major airline hiring to 3,200 per year would result in a 12.3-percent decrease in total force size of USAF pilots in the steady state. Offsetting this decrease in force size would require an increase in ARP from $25,000 to at least $38,500 and perhaps more, if ARP continues to be offered over most of a career. We also found that eliminating the payment of AP to pilots in non-flying positions would reduce the pilot force size by 0.9 to 1.1 percent.

Figure 7.9
Simulated Steady-State Effect on USAF Pilot Retention of Elimination of AP for Non-Flying Positions When Probability of Being Hired by a Major Airline Is 0.4 (2,900 Hires per Year)

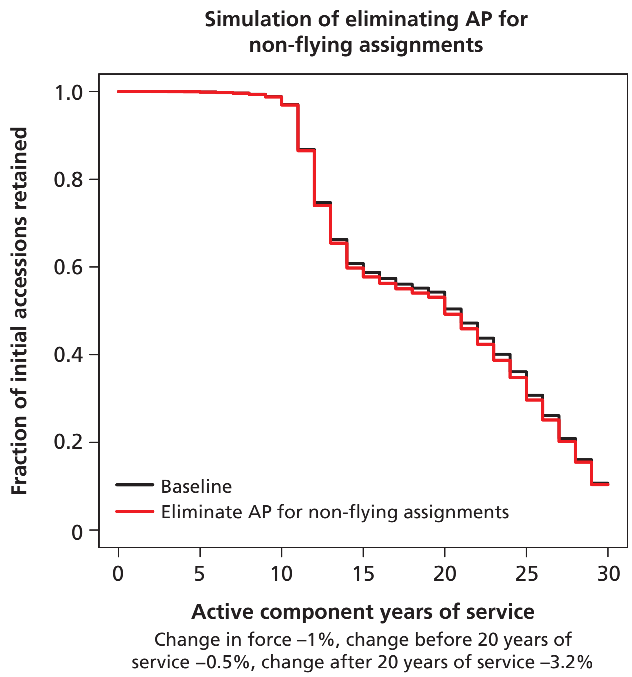

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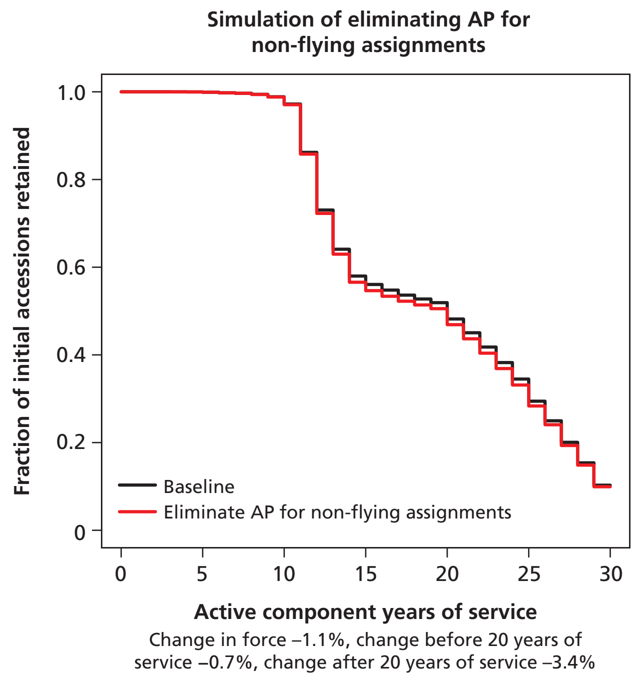
Figure 7.10
Simulated Steady-State Effect on USAF Pilot Retention of Elimination of AP for Non-Flying Positions When Probability of Being Hired by a Major Airline Is 0.5 (3,200 Hires per Year)



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CHAPTER EIGHT

Concluding Thoughts

We began this research with several objectives in mind. These were to develop a capability useful in justifying the levels of funding requested for AP and ARP, to assess whether there will be a pilot shortage in commercial aviation that will accelerate the outflow of Air Force pilots, and to determine whether timely increases in AP and ARP could prevent this.

The need to justify the budget requests for AP and ARP funding arose because these programs became discretionary. Our approach to assisting in budget justification was to model the retention response to increases in AP and ARP and to assess the pilot supply and demand conditions among major airlines. We extended the DRM to handle multiple entry cohorts of pilots and implemented an improved method of modeling a pilot's choice among multi-year ARP contracts. We also increased the number of years covered by the data used in estimating the DRM and have carefully accounted for changes in the ARP offer over time. Further, we added two variables to the model, the unemployment rate and the level of hiring by the major airlines, to control for economic conditions and pilot employment opportunities. In addition, we analyzed civilian earnings for both pilots and non-pilots and identified the 80th percentile of veteran pilots' age-earnings curve to use in estimating the DRM. The model fits the pilot retention data well, and the multiple cohorts and rich modeling of ARP provide natural variation that is valuable in estimating the effect of ARP on retention.

Based on our assessment of supply and demand, we expect that the demand for pilots by major airlines will increase. The increase in hiring will occur because (1) increasing numbers of pilots at major airlines will reach mandatory retirement age in the next ten years and (2) the demand for passenger and cargo miles will increase, which will add to the demand for pilots to some extent. Pay at major airlines has been rising and will continue to increase for the next few years, at least. This is a result of labor agreements already in place. Thus, both hiring and pay will increase at major airlines.

We found a negative effect of higher civilian pay (compared to military pay) on Air Force pilot retention in the DRM. We also found a negative effect of major airline hiring on pilot retention at the end of ADSC, which accords with past studies. We explored the impact on retention over a range of civilian pay and hiring increases and determined the level and type of ARP offers that could offset the impact. We also found that today's cap on ARP might be too low. Raising the cap would increase ARP's ability to sustain retention. This does not mean that we recommend that the Air Force should immediately offer a higher ARP to all pilots or even to all rated personnel. Whether the Air Force should do so will depend on pilot requirements in the coming years and on whether retention is insufficient to meet requirements. The analysis here argues for increasing the cap as a prudent measure for enabling a rapid response.

Finally, we found that eliminating the payment of AP to pilots in non-flying positions would cause a decrease in retention of 0.9 to 1.1 percent, depending on the demand for pilots by major airlines.

A limitation in our work was the absence of data on the jobs taken by rated officers when they leave the military. How many become large airline pilots, how does this vary by type of aircraft flown in the military and by years of service at exit, and how does the choice of pilot/non-pilot job vary with economic conditions? Data of this type could be routinely collected by longitudinal surveys of rated officers followed into the civilian world after the military or by cross-sectional surveys of rated officers who have left the military, with data linkable to their military personnel record.

APPENDIX A

Civilian Earnings Analysis for Pilots and Non-Pilots

American Community Survey Sample

We used the ACS for all available survey years, 2003 through 2012. The surveys ask about earnings in the previous years, so the earnings years are 2002 through 2011. We converted earnings to constant 2013 dollars using the Consumer Price Index for All Urban Consumers (CPI-U). The sample has only full-time, full-year workers—i.e., those with 40 or more usual weekly hours of work and 50–52 weeks worked in a year. The earnings analysis will, therefore, not show how pilot furloughs, which led to fewer than 50 weeks worked, affected pilot earnings. The analysis should provide reliable estimates of the amount that a pilot or non-pilot would earn from full employment. Also, the sample is limited to persons with four or more years of college. This is relevant for projecting the wages of military officers, who almost all have four or more years of college.

ACS income-related data are top-coded—i.e., incomes above a certain threshold are flagged as being above the threshold value, and those incomes are not reported. The top-code threshold varies by state. The ACS flags respondents with earnings above the threshold and imputes earnings equal to mean earnings in the state, conditional on being above the threshold. In our case, top-coding cannot be ignored because some fraction of highly educated workers is likely to be above the threshold. At the same time, using imputed earnings seems inappropriate for pilots because top-coded pilots are likely to have earnings below the conditional mean. Our approach to top-coding is to use a right-censored Tobit model to estimate earnings regressions. Earnings above the threshold are, by definition, right-censored. The Tobit model accounts for this by entering an expression for the probability of earnings being above the threshold in the sample likelihood. For earnings below the threshold, the Tobit model enters an expression for the probability of the exact value of the earnings. If we did not control for top-coding, the regression estimates would be biased downward. Specifically, the increase in earnings with age would be shallower than actual.

The sample means for key variables are shown in Table A.1. Among pilots, earnings of veterans are higher than those of non-veterans. To some extent, this reflects earnings growth with age and the fact that veterans are, on average, seven years older in this sample. However, when compared with the pilot pay scales for large airlines, it is unrealistic to think that the average earnings of pilots reflect the average earnings at large airlines. For veteran pilots, for example, average earnings of $115,301 might correspond to 1,000 hours of flying at an hourly rate of $115 or to 900 hours of flying at an hourly rate of $128. These hourly rates are in the range of a first officer with less than seven years of tenure, but the majority of pilots have more tenure than that. This is to emphasize that earnings relevant to pilots at the large airlines will

Table A.1
Sample Means

	Pilots		Non-Pilots	
	Veteran	Non-Veteran	Veteran	Non-Veteran
Earnings (in 2013 dollars)	$115,301	$90,466	$82,675	$74,693
Age	47.52	40.45	51.08	41.74
Female	0.0167	0.0739	0.1024	0.4602
>4 years of college	0.2581	0.0981	0.3646	0.3458
Veteran 2001–2010	0.2994	--	0.2500	--
Size	2,518	2,614	187,536	2,248,580

lie on a percentile higher than that for average earnings. The means also indicate that a small percentage of pilots are female, especially among veterans. A quarter of veteran pilots have more than four years of college versus 10 percent of non-veteran pilots. Among pilots who are veterans, 30 percent served in the military and departed from it in the last decade.

For non-pilots, veterans earn on average $8,000 a year more than non-veterans, and again this likely reflects the older age of veterans, 51 years versus 42 years. About 10 percent of the veterans are female, much less than the 46 percent among non-veterans. The percentage with more than four years of college is similar between veterans and non-veterans, at about 35 percent. Finally, among non-pilots who are veterans, 25 percent served in the military in the last decade.

The table of means omits the means of the year indicators. However, the sample sizes are fairly even across the ten survey years (2003–2012), with about 10 percent of the sample in each year. The table also omits the means for the threshold quartile indicators. These were created such that a quarter of the states were in each threshold. However, because individuals in the sample are not necessarily evenly spread across the states, the percentage of individuals in each quartile differs. The threshold quartile indicators were created to guard against the possibility that higher-earning older pilots tend to live in states with higher thresholds; more generally, a correlation between the threshold and other explanatory variables raises the prospect that the coefficients on those variables could be biased if the controls were not included.

Regression Specification

We use a log-linear specification and assume that the error is normally distributed.

$$\begin{aligned}\ln(Earnings) &= \beta_0 + \beta_1 Age + \beta_2 Age^2 + \beta_3 Female \\ &+ \beta_4 Morethan4yearsofcollege + \beta_5 Veteran \\ &+ \beta_6 Veteran2001to2011 + \sum_{2003}^{2011} \delta_t + \sum_{2}^{4} \delta_q + \varepsilon\end{aligned}$$

The natural log of earnings is a linear function of age, age squared, gender, education level, veteran status, year indicators, threshold quartile indicators, and an error term. The reference group (or omitted group) is non-veteran males with four years of college in year 2002 and in a state with a threshold in the lowest quartile of thresholds. The data are at the individual level, though an *i* subscript is omitted from the specification. The Tobit model returns estimates of the parameters on the right-hand side, as well as an estimate of the standard deviation of the error term.

Regression Estimates

The regression results are shown in Table A.2. A major finding is that earnings increase more rapidly with age for pilots than for non-pilots. This is shown below, where we use the regression estimates to compute earnings-age profiles by percentile.

Other findings from the regressions are as follows:

- Pilots with more than four years of college earn no more than pilots with four years of college. This may reflect the fact that pilot pay scales make no adjustment for the level of education. Non-pilots, however, receive a big boost in earnings if they have more than four years of college—earnings are about 27 percent higher.
- Pilots who were veterans earn about 16 percent more than non-veteran pilots. However, when veteran pilots start out, they earn about 5 percent less than other veterans, as seen by the veteran 2001–2011 coefficient. Stated differently, among pilots, recent veterans earn about 11 percent more than non-veterans, and, judging by the experience of veterans in exit cohorts before 2001, this climbs to 16 percent as the veterans settle into their civilian pilot careers. The lower earnings of non-veteran pilots could result from veterans being more likely to work for major airlines, which have higher pay scales than small airlines. As mentioned, the conventional wisdom is that ex-military pilots would only seek a position with a major airline if they wanted to fly.
- Earnings increase with age to the mid-50s, then decrease. The decrease in earnings could reflect a decrease in hours flown. Also, there could be differences in life-cycle wages for different labor market entry cohorts. Life-cycle wages might be higher for college-educated workers entering today than for those entering 30 years ago, and in cross-sectional data like the ACS, this could cause the wage-age curve to turn down at older ages.
- Female pilots earn about 14 percent less than male pilots, but among non-pilots females earn 25 percent less. Female pilots' lower earnings could result from being more likely to work at small airlines, which have lower pay scales, or working fewer hours a year.
- Year effects differ between pilots and non-pilots. Relative to 2002, the base year in the regression, non-pilots earned the same or up to 4 percent more in subsequent years. But pilots earned about 6 to 8 percent less from 2005 onward than in 2002.
- The top-code controls are statistically significant and positive. For pilots, the coefficients are similar across the third quartile (low-mid threshold), second quartile (mid-high threshold), and first quartile (high threshold) and imply earnings about 5 percent higher than in the lowest threshold quartile. For non-pilots, earnings are about 5 percent higher in the low-mid and mid-high quartiles, but about 20 percent higher in the highest threshold quartile.

Table A.2
Right-Censored Tobit Model Ln(Earnings) Regression Estimates

	Pilots			Non-Pilots		
	Estimate	Standard Error	*t* Value	Estimate	Standard Error	*t* Value
Intercept	7.483618	0.133029	56.26	9.054243	0.005531	1,636.97
Age	0.160335	0.005916	27.10	0.085562	0.000238	359.61
Age squared	–0.001527	0.000066	–23.08	–0.000852	0.000003	–321.44
Female	–0.151006	0.036873	–4.10	–0.293775	0.000808	–363.77
> 4 years of college	–0.000364	0.020174	–0.02	0.239257	0.000820	291.85
Veteran	0.150992	0.019328	7.81	–0.027620	0.001593	–17.34
Veteran 2001–2011	–0.056409	0.025796	–2.19	0.001325	0.003000	0.44
2003	–0.040453	0.050757	–0.80	0.034961	0.002705	12.92
2004	0.018295	0.042677	0.43	0.043786	0.002288	19.14
2005	–0.080649	0.041832	–1.93	0.025563	0.002265	11.28
2006	–0.060190	0.041325	–1.46	0.052239	0.002259	23.12
2007	–0.090203	0.040722	–2.22	0.013074	0.002216	5.90
2008	–0.084727	0.041217	–2.06	0.037526	0.002219	16.91
2009	–0.089183	0.041310	–2.16	0.018212	0.002217	8.21
2010	–0.030080	0.042521	–0.71	–0.004712	0.002229	–2.11
2011	–0.086925	0.042070	–2.07	–0.009520	0.002225	–4.28
Low-mid threshold	0.052025	0.020135	2.58	0.051738	0.001124	46.02
Mid-high threshold	0.039224	0.018457	2.13	0.050365	0.000900	55.95
High threshold	0.050571	0.019779	2.56	0.195946	0.000889	220.41
Sigma	0.558641	0.005810	96.15	0.619721	0.000288	2,151.10
Observations	5,536			2,539,165		
Number censored	605			131,000		
Percentage censored	10.9			5.2		

- Sigma is the estimated standard deviation of the error term in the log earnings equation. It is smaller for pilots than for non-pilots, 0.56 versus 0.62. This is consistent with pilot pay scales having a lower maximum than that for non-pilots, where earnings are in general not governed by a pay scale and can range well above $500,000 on the upper end and below pilot pay scales on the lower end. Even though sigma is higher for non-pilots than for pilots, the percentage of observations that are censored (top-coded) is lower for non-pilots, 5.2 percent versus 10.9 percent for pilots. The implication is that more pilots have earnings above the threshold, although their earnings do not extend as far above the threshold as those for non-pilots.

Predicted Earnings for Veteran Pilots and Non-Pilots, by Earnings Percentile, Age, and Education

We use the right-censored Tobit regression estimates to predict earnings by age by earnings percentile. In all cases, the predictions are for male veterans who served on active duty in the military. The regressions include year effects, and we use the latest year, 2011, in the predictions. The predicted earnings are stated in 2013 dollars. There are two education levels, four years of college and more than four years of college. There is little difference in earnings by education level for veterans working as pilots, but we include tables for both levels of education for completeness. There is a considerable difference in earnings by education level for veterans working as non-pilots, however. (See Tables A.3–A.6.)

Table A.3
Predicted Earnings for Male Veteran Pilots with Four Years of College

	Percentile						
Age	**40th**	**50th**	**60th**	**70th**	**80th**	**90th**	**Mean**
30	$51,119	$58,890	$67,844	$78,936	$94,240	$120,495	$68,836
31	$54,671	$62,983	$72,559	$84,421	$100,789	$128,869	$73,619
32	$58,292	$67,155	$77,365	$90,013	$107,465	$137,404	$78,496
33	$61,964	$71,385	$82,238	$95,682	$114,234	$146,059	$83,439
34	$65,666	$75,649	$87,151	$101,399	$121,058	$154,785	$88,424
35	$69,377	$79,924	$92,076	$107,129	$127,899	$163,532	$93,421
36	$73,074	$84,183	$96,982	$112,838	$134,715	$172,246	$98,400
37	$76,733	$88,399	$101,839	$118,488	$141,461	$180,872	$103,327
38	$80,330	$92,543	$106,613	$124,042	$148,092	$189,350	$108,171
39	$83,839	$96,585	$111,270	$129,461	$154,561	$197,622	$112,896
40	$87,234	$100,497	$115,776	$134,704	$160,821	$205,626	$117,468
41	$90,491	$104,249	$120,098	$139,732	$166,824	$213,301	$121,853
42	$93,582	$107,810	$124,201	$144,506	$172,524	$220,588	$126,016
43	$96,484	$111,153	$128,053	$148,988	$177,874	$227,429	$129,924
44	$99,173	$114,251	$131,621	$153,140	$182,831	$233,767	$133,545
45	$101,626	$117,077	$134,877	$156,927	$187,353	$239,549	$136,848
46	$103,822	$119,607	$137,791	$160,318	$191,401	$244,725	$139,805
47	$105,742	$121,818	$140,339	$163,283	$194,941	$249,251	$142,390
48	$107,369	$123,693	$142,499	$165,795	$197,940	$253,086	$144,581
49	$108,689	$125,213	$144,250	$167,833	$200,373	$256,197	$146,358
50	$109,689	$126,366	$145,578	$169,378	$202,217	$258,555	$147,705
51	$110,361	$127,140	$146,470	$170,415	$203,456	$260,139	$148,610
52	$110,699	$127,529	$146,918	$170,937	$204,079	$260,934	$149,065
53	$110,699	$127,529	$146,918	$170,937	$204,079	$260,934	$149,065
54	$110,361	$127,140	$146,470	$170,415	$203,456	$260,139	$148,610
55	$109,689	$126,366	$145,578	$169,378	$202,217	$258,555	$147,705
56	$108,689	$125,213	$144,250	$167,833	$200,373	$256,197	$146,358
57	$107,369	$123,693	$142,499	$165,795	$197,940	$253,086	$144,581
58	$105,742	$121,818	$140,339	$163,283	$194,941	$249,251	$142,390
59	$103,822	$119,607	$137,791	$160,318	$191,401	$244,725	$139,805
60	$101,626	$117,077	$134,877	$156,927	$187,353	$239,549	$136,848
61	$99,173	$114,251	$131,621	$153,140	$182,831	$233,767	$133,545
62	$96,484	$111,153	$128,053	$148,988	$177,874	$227,429	$129,924
63	$93,582	$107,810	$124,201	$144,506	$172,524	$220,588	$126,016
64	$90,491	$104,249	$120,098	$139,732	$166,824	$213,301	$121,853
65	$87,234	$100,497	$115,776	$134,704	$160,821	$205,626	$117,468

Table A.4
Predicted Earnings for Male Veteran Pilots with More Than Four Years of College

	Percentile						
Age	40th	50th	60th	70th	80th	90th	Mean
30	$51,100	$58,869	$67,819	$78,907	$94,206	$120,451	$68,810
31	$54,651	$62,960	$72,532	$84,391	$100,753	$128,822	$73,593
32	$58,271	$67,130	$77,337	$89,980	$107,426	$137,354	$78,467
33	$61,941	$71,359	$82,208	$95,647	$114,192	$146,006	$83,409
34	$65,642	$75,622	$87,119	$101,362	$121,014	$154,728	$88,392
35	$69,351	$79,895	$92,042	$107,090	$127,853	$163,472	$93,387
36	$73,047	$84,153	$96,947	$112,797	$134,666	$172,184	$98,364
37	$76,705	$88,367	$101,802	$118,445	$141,410	$180,806	$103,290
38	$80,301	$92,509	$106,574	$123,997	$148,038	$189,281	$108,131
39	$83,808	$96,550	$111,229	$129,414	$154,505	$197,550	$112,855
40	$87,203	$100,461	$115,734	$134,655	$160,763	$205,551	$117,426
41	$90,458	$104,211	$120,054	$139,682	$166,764	$213,224	$121,809
42	$93,548	$107,771	$124,156	$144,454	$172,461	$220,508	$125,970
43	$96,449	$111,113	$128,006	$148,933	$177,809	$227,346	$129,877
44	$99,137	$114,209	$131,573	$153,084	$182,764	$233,682	$133,496
45	$101,589	$117,034	$134,827	$156,870	$187,285	$239,462	$136,798
46	$103,784	$119,563	$137,741	$160,260	$191,332	$244,636	$139,754
47	$105,703	$121,774	$140,288	$163,223	$194,870	$249,160	$142,338
48	$107,330	$123,648	$142,447	$165,735	$197,868	$252,994	$144,529
49	$108,649	$125,168	$144,197	$167,772	$200,300	$256,103	$146,305
50	$109,649	$126,320	$145,525	$169,316	$202,144	$258,461	$147,652
51	$110,321	$127,094	$146,416	$170,353	$203,382	$260,044	$148,556
52	$110,658	$127,482	$146,864	$170,874	$204,004	$260,839	$149,011
53	$110,658	$127,482	$146,864	$170,874	$204,004	$260,839	$149,011
54	$110,321	$127,094	$146,416	$170,353	$203,382	$260,044	$148,556
55	$109,649	$126,320	$145,525	$169,316	$202,144	$258,461	$147,652
56	$108,649	$125,168	$144,197	$167,772	$200,300	$256,103	$146,305
57	$107,330	$123,648	$142,447	$165,735	$197,868	$252,994	$144,529
58	$105,703	$121,774	$140,288	$163,223	$194,870	$249,160	$142,338
59	$103,784	$119,563	$137,741	$160,260	$191,332	$244,636	$139,754
60	$101,589	$117,034	$134,827	$156,870	$187,285	$239,462	$136,798
61	$99,137	$114,209	$131,573	$153,084	$182,764	$233,682	$133,496
62	$96,449	$111,113	$128,006	$148,933	$177,809	$227,346	$129,877
63	$93,548	$107,771	$124,156	$144,454	$172,461	$220,508	$125,970
64	$90,458	$104,211	$120,054	$139,682	$166,764	$213,224	$121,809
65	$87,203	$100,461	$115,734	$134,655	$160,763	$205,551	$117,426

Table A.5
Predicted Earnings for Male Veteran Non-Pilots with Four Years of College

	Percentile						
Age	40th	50th	60th	70th	80th	90th	Mean
30	$42,623	$49,869	$58,347	$69,020	$84,014	$110,345	$60,427
31	$44,079	$51,573	$60,340	$71,377	$86,883	$114,114	$62,491
32	$45,508	$53,244	$62,295	$73,690	$89,699	$117,812	$64,516
33	$46,902	$54,875	$64,204	$75,948	$92,447	$121,422	$66,493
34	$48,257	$56,461	$66,059	$78,142	$95,118	$124,929	$68,414
35	$49,566	$57,993	$67,852	$80,262	$97,699	$128,319	$70,270
36	$50,825	$59,465	$69,574	$82,300	$100,179	$131,577	$72,054
37	$52,026	$60,871	$71,219	$84,246	$102,547	$134,688	$73,757
38	$53,166	$62,204	$72,778	$86,090	$104,793	$137,637	$75,373
39	$54,237	$63,458	$74,246	$87,826	$106,905	$140,412	$76,892
40	$55,236	$64,627	$75,613	$89,444	$108,875	$142,998	$78,308
41	$56,158	$65,705	$76,875	$90,936	$110,692	$145,385	$79,615
42	$56,998	$66,688	$78,025	$92,296	$112,347	$147,559	$80,806
43	$57,752	$67,570	$79,057	$93,517	$113,833	$149,511	$81,875
44	$58,417	$68,347	$79,967	$94,593	$115,143	$151,231	$82,817
45	$58,988	$69,016	$80,749	$95,518	$116,269	$152,710	$83,627
46	$59,464	$69,572	$81,400	$96,289	$117,207	$153,941	$84,301
47	$59,841	$70,014	$81,916	$96,900	$117,950	$154,918	$84,836
48	$60,118	$70,338	$82,296	$97,349	$118,497	$155,636	$85,229
49	$60,294	$70,544	$82,536	$97,633	$118,843	$156,091	$85,478
50	$60,367	$70,629	$82,637	$97,752	$118,987	$156,280	$85,582
51	$60,337	$70,595	$82,596	$97,704	$118,929	$156,204	$85,540
52	$60,205	$70,440	$82,415	$97,490	$118,669	$155,862	$85,353
53	$59,971	$70,166	$82,094	$97,110	$118,207	$155,255	$85,021
54	$59,636	$69,774	$81,636	$96,568	$117,547	$154,388	$84,546
55	$59,202	$69,266	$81,042	$95,865	$116,691	$153,264	$83,930
56	$58,671	$68,645	$80,315	$95,005	$115,644	$151,889	$83,177
57	$58,046	$67,913	$79,459	$93,993	$114,412	$150,271	$82,291
58	$57,329	$67,075	$78,478	$92,833	$113,000	$148,416	$81,275
59	$56,525	$66,135	$77,378	$91,531	$111,415	$146,335	$80,136
60	$55,638	$65,096	$76,163	$90,094	$109,666	$144,037	$78,877
61	$54,671	$63,965	$74,839	$88,528	$107,760	$141,534	$77,507
62	$53,629	$62,747	$73,414	$86,842	$105,707	$138,838	$76,030
63	$52,518	$61,446	$71,892	$85,042	$103,517	$135,961	$74,455
64	$51,343	$60,071	$70,283	$83,138	$101,200	$132,917	$72,788
65	$50,108	$58,626	$68,592	$81,139	$98,765	$129,721	$71,037

Table A.6
Predicted Earnings for Male Veteran Non-Pilots with More Than Four Years of College

	Percentile						
Age	40th	50th	60th	70th	80th	90th	Mean
30	$54,145	$63,349	$74,119	$87,676	$106,723	$140,172	$76,761
31	$55,994	$65,513	$76,651	$90,671	$110,369	$144,960	$79,383
32	$57,809	$67,636	$79,134	$93,609	$113,944	$149,657	$81,955
33	$59,580	$69,709	$81,559	$96,477	$117,436	$154,243	$84,466
34	$61,301	$71,722	$83,915	$99,264	$120,828	$158,698	$86,906
35	$62,964	$73,668	$86,192	$101,958	$124,107	$163,005	$89,264
36	$64,563	$75,539	$88,380	$104,546	$127,258	$167,143	$91,530
37	$66,089	$77,324	$90,470	$107,018	$130,266	$171,094	$93,694
38	$67,537	$79,018	$92,451	$109,361	$133,119	$174,841	$95,746
39	$68,898	$80,611	$94,315	$111,566	$135,802	$178,366	$97,676
40	$70,167	$82,096	$96,052	$113,621	$138,304	$181,651	$99,476
41	$71,338	$83,466	$97,655	$115,517	$140,612	$184,683	$101,136
42	$72,405	$84,714	$99,115	$117,245	$142,715	$187,445	$102,648
43	$73,363	$85,835	$100,427	$118,796	$144,603	$189,925	$104,006
44	$74,207	$86,822	$101,582	$120,162	$146,267	$192,109	$105,203
45	$74,933	$87,671	$102,576	$121,338	$147,697	$193,989	$106,232
46	$75,537	$88,378	$103,403	$122,316	$148,888	$195,553	$107,088
47	$76,016	$88,939	$104,059	$123,092	$149,833	$196,794	$107,768
48	$76,368	$89,351	$104,541	$123,662	$150,527	$197,705	$108,267
49	$76,592	$89,612	$104,846	$124,024	$150,967	$198,283	$108,583
50	$76,685	$89,721	$104,974	$124,174	$151,150	$198,524	$108,715
51	$76,647	$89,677	$104,922	$124,114	$151,076	$198,427	$108,662
52	$76,479	$89,480	$104,692	$123,842	$150,745	$197,992	$108,424
53	$76,181	$89,132	$104,285	$123,360	$150,159	$197,221	$108,002
54	$75,756	$88,634	$103,702	$122,671	$149,320	$196,120	$107,399
55	$75,204	$87,989	$102,948	$121,778	$148,233	$194,692	$106,617
56	$74,530	$87,200	$102,024	$120,685	$146,903	$192,946	$105,661
57	$73,736	$86,271	$100,937	$119,399	$145,338	$190,890	$104,535
58	$72,826	$85,206	$99,691	$117,926	$143,544	$188,534	$103,244
59	$71,804	$84,011	$98,293	$116,272	$141,531	$185,890	$101,797
60	$70,677	$82,692	$96,750	$114,446	$139,309	$182,971	$100,198
61	$69,449	$81,255	$95,069	$112,458	$136,888	$179,792	$98,457
62	$68,126	$79,707	$93,258	$110,315	$134,281	$176,367	$96,582
63	$66,714	$78,056	$91,325	$108,030	$131,498	$172,712	$94,580
64	$65,221	$76,308	$89,281	$105,611	$128,554	$168,846	$92,463
65	$63,652	$74,473	$87,133	$103,071	$125,462	$164,785	$90,239

APPENDIX B

Present Discounted Value of Earnings

Tables B.1 and B.2 show the present discounted value (PDV) of earnings for veteran pilots and non-pilots with, respectively, four years of college and more than four years of college. The PDV calculations imply that the earnings advantage of being a pilot decreases as the age of leaving the military increases.

Table B.1
Present Discounted Value of Earnings of Male Veteran Pilots and Non-Pilots with Four Years of College, by Earnings Percentile and Age When Leaving the Military

		Exit Age				
Percentile	**Occupation**	**30**	**35**	**40**	**45**	**50**
80th	PV pilot	$2,383,204	$2,256,459	$2,065,288	$1,798,014	$1,451,650
90th	PV non-pilot	$2,124,091	$2,141,609	$2,064,222	$1,883,445	$1,596,927
80th	PV non-pilot	$1,617,222	$1,630,559	$1,571,639	$1,434,001	$1,215,855
70th	PV non-pilot	$1,328,594	$1,339,551	$1,291,147	$1,178,073	$998,860
60th	PV non-pilot	$1,123,157	$1,132,420	$1,091,501	$995,911	$844,409
50th	PV non-pilot	$959,963	$967,880	$932,906	$851,206	$721,716
40th	PV non-pilot	$820,480	$827,247	$797,355	$727,526	$616,851

NOTE: PV = present value.

Table B.2
Present Discounted Value of Earnings of Male Veteran Pilots and Non-Pilots with More Than Four Years of College, by Earnings Percentile and Age When Leaving the Military

		Exit Age				
Percentile	**Occupation**	**30**	**35**	**40**	**45**	**50**
80th	PV pilot	$2,382,337	$2,255,638	$2,064,536	$1,797,360	$1,451,122
90th	PV non-pilot	$2,698,243	$2,720,496	$2,622,191	$2,392,550	$2,028,585
80th	PV non-pilot	$2,054,365	$2,071,308	$1,996,461	$1,821,619	$1,544,506
70th	PV non-pilot	$1,687,720	$1,701,639	$1,640,150	$1,496,512	$1,268,856
60th	PV non-pilot	$1,426,752	$1,438,519	$1,386,539	$1,265,111	$1,072,657
50th	PV non-pilot	$1,219,446	$1,229,503	$1,185,075	$1,081,291	$916,800
40th	PV non-pilot	$1,042,260	$1,050,856	$1,012,884	$924,179	$783,589

The PDVs are computed for various ages at which a veteran leaves the military, ranging from ages 30 to 50. The personal discount rate is 6 percent, which accords with our DRM estimate of the personal discount rate for officers. The PDV for pilots uses earnings at the 80th percentile, assumes that earnings increase with tenure, and uses the earnings curve starting at age 30 to proxy for earnings by tenure. Thus, if a pilot starts at age 30, earnings are paid according to 80th-percentile earnings and increase with tenure up to 35 years when the pilot retires at age 65. If a pilot starts at age 40, earnings equal the amount shown for a pilot starting at age 30 and increase up to 25 years of tenure. The PDV calculation for non-pilots assumes that the veteran earnings begin at a level corresponding to the age of leaving the military and continue to age 65. PDVs are shown for the 40th through 90th earnings percentiles.

Following our interpretation, the most relevant earnings percentile for veteran pilots is the 80th. At this percentile, the PDV is highest if the veteran leaves the military at age 30—nearly $2.4 million. It is about $2 million for a veteran leaving the military at age 40 and $1.45 million at age 50. The PDVs are essentially the same for veteran pilots with four years of college or more than four years of college.

The PDVs for veteran non-pilots are lower. Veterans who leave the military at age 30 and have four years of college have PDVs of $2.1 million at the 90th percentile, $1.3 million at the 70th, and $0.96 million at the 50th. These PDVs are all less than that of a veteran pilot at the 80th percentile. The PDVs for veteran non-pilots who leave the military at age 30 and have more than four years of college are $2.7 million at the 90th percentile, $1.7 million at the 70th, and $1.2 million at the 50th. The PDV for veteran pilots at the 80th percentile is still higher in all cases except for the PDV at the 90th percentile ($2.7 million versus $2.4 million).

We conclude that if the choice of occupations depended only on the civilian earnings stream, a military pilot would, in most cases, maximize civilian earnings by leaving active duty at the end of ADSC and going to work for a large airline, if possible. The monetary incentive to work for a large airline rather than at another occupation drops with age but remains at least to age 50 for military pilots with four years of college, except for those with exceptionally high earnings opportunities in non-pilot occupations—e.g., earnings that would place them at the 90th percentile, in which case the monetary advantage of working for a large airline ends at age 40. For military pilots with more than four years of college, non-pilot occupations are relatively more attractive, but being a pilot for a large airline is still absolutely more attractive unless non-pilot earnings are at the 90th percentile, or, for those leaving the military after age 45, unless non-pilot earnings are at least at the 80th percentile.

APPENDIX C

Aviator Retention Pay Program, 2000–2013

Aviator retention pay (ARP), known as aviator continuation pay (ACP) until 2013, is a major special pay critical to the retention of pilots. The detailed offerings of ARP have varied from year to year, as shown in Table C.1. This table is based on records available at AFPC. These changes represent changes in the choice set of aviators considering whether to participate in ARP and, if so, how many years of obligated service to select. These details have been coded into the DRM to provide an accurate rendering of the choice set.

Table C.1
ARP (ACP) Program, 2000–2013

Year	Rating	Platform	Category	Eligibility	Total Years	Pay per Year	Percentage of Total Amount That Is Available in First Year of Commitment
2000	Pilots	Any	Other	<22 YAS	3	$15,000	Level
2000	Pilots	Any	Other	<20 YAS	5	$25,000	Level
2000	Pilots	Any	Other	<17 YAS	to 20 YAS	$25,000	Level
2000	Pilots	Any	Other	<22 YAS	to 25 YAS	$25,000	Level
2000	Pilots	Any	Other	>22 YAS	to 25 YAS	$15,000	Level
2000	Pilots	Any	Other	O-6	5	$25,000	Level
2000	Pilots	Any	Other	O-6	to 25 YAS	$25,000	Level
2000	Pilots	Any	Initial		3	$15,000	Up to 50%, ≤$100,000
2000	Pilots	Any	Initial		5	$25,000	Up to 50%, ≤$100,000
2000	Pilots	Any	Initial		to 20 YAS	$25,000	Up to 50%, ≤$100,000
2000	Pilots	Any	Initial		to 25 YAS	$25,000	Up to 50%, ≤$100,000
2001	Pilots	Any	Initial	<22 YAS	3	$15,000	50% or level
2001	Pilots	Any	Initial	<20 YAS	5	$25,000	20–50% in 10% increments, ≤$150,000
2001	Pilots	Any	Initial	<17 YAS	to 20 YAS	$25,000	20–50% in 10% increments, ≤$150,000
2001	Pilots	Any	Initial	<22 YAS	to 25 YAS	$25,000	20–50% in 10% increments, ≤$150,000
2001	Pilots	Any	Initial	>22 YAS	to 25 YAS	$15,000	20–50% in 10% increments, ≤$150,000
2001	Pilots	Any	Other	<22 YAS	3	$15,000	50% or level
2001	Pilots	Any	Other	<20 YAS	5	$25,000	20–50% in 10% increments, ≤$150,000
2001	Pilots	Any	Other	<17 YAS	to 20 YAS	$25,000	20–50% in 10% increments, ≤$150,000
2001	Pilots	Any	Other	<22 YAS	to 25 YAS	$25,000	20–50% in 10% increments, ≤$150,000

Table C.1—continued

Year	Rating	Platform	Category	Eligibility	Total Years	Pay per Year	Percentage of Total Amount That Is Available in First Year of Commitment
2001	Pilots	Any	Other	>22 YAS	to 25 YAS	$15,000	20–50% in 10% increments, ≤$150,000
2002	Pilots	Any	Initial	<22 YAS	3	$15,000	50% or level
2002	Pilots	Any	Initial	<20 YAS	5	$25,000	20–50% in 10% increments, ≤$150,000
2002	Pilots	Any	Initial	<17 YAS	to 20 YAS	$25,000	20–50% in 10% increments, ≤$150,000
2002	Pilots	Any	Initial	<22 YAS	to 25 YAS	$25,000	20–50% in 10% increments, ≤$150,000
2002	Pilots	Any	Initial	>22 YAS	to 25 YAS	$15,000	20–50% in 10% increments, ≤$150,000
2002	CSO/ ABMs	Any	Initial	<22 YAS, <O-6 Select	3	$10,000	50% or level
2002	CSO/ ABMs	Any	Initial	<20 YAS	5	$15,000	20–50% in 10% increments, ≤$150,000
2002	CSO/ ABMs	Any	Initial	<17 YAS, <O-6 Select	to 20 YAS	$15,000	20–50% in 10% increments, ≤$150,000
2002	CSO/ ABMs	Any	Initial	<22 YAS	to 25 YAS	$15,000	20–50% in 10% increments, ≤$150,000
2002	CSO/ ABMs	Any	Initial	>22 YAS	to 25 YAS	$10,000	20–50% in 10% increments, ≤$150,000
2002	Pilots	Any	Other	<22 YAS	3	$15,000	Level
2002	Pilots	Any	Other	<20 YAS	5	$25,000	Level
2002	Pilots	Any	Other	<17 YAS	to 20 YAS	$25,000	Level
2002	Pilots	Any	Other	<22 YAS	to 25 YAS	$25,000	Level
2002	Pilots	Any	Other	>22 YAS	to 25 YAS	$15,000	Level
2002	CSO/ ABMs	Any	Other	<22 YAS, <O-6 Select	3	$10,000	Level
2002	CSO/ ABMs	Any	Other	<20 YAS	5	$15,000	Level
2002	CSO/ ABMs	Any	Other	<17 YAS, <O-6 Select	to 20 YAS	$15,000	Level

Table C.1—continued

Year	Rating	Platform	Category	Eligibility	Total Years	Pay per Year	Percentage of Total Amount That Is Available in First Year of Commitment
2002	CSO/ ABMs	Any	Other	<22 YAS	to 25 YAS	$15,000	Level
2002	CSO/ ABMs	Any	Other	>22 YAS	to 25 YAS	$10,000	Level
2003	Pilots	Any	Initial	<22 YAS, <O-6 Select	3	$15,000	50% or level
2003	Pilots	Any	Initial	<20 YAS	5	$25,000	20–50% in 10% increments, ≤$150,000
2003	Pilots	Any	Initial	<17 YAS	to 20 YAS	$25,000	20–50% in 10% increments, ≤$150,000
2003	Pilots	Any	Initial	<22 YAS	to 25 YAS	$25,000	20–50% in 10% increments, ≤$150,000
2003	Pilots	Any	Initial	>22 YAS	to 25 YAS	$15,000	20–50% in 10% increments, ≤$150,000
2003	Pilots	Any	Other	<22 YAS, <O-6 Select	3	$15,000	Level
2003	Pilots	Any	Other	<20 YAS	5	$25,000	Level
2003	Pilots	Any	Other	<17 YAS	to 20 YAS	$25,000	Level
2003	Pilots	Any	Other	<22 YAS	to 25 YAS	$25,000	Level
2003	Pilots	Any	Other	>22 YAS	to 25 YAS	$15,000	Level
2003	CSO	Any	Any	15≤YAS≤22, <O-6 Select, 18<TAFMS]	3	$10,000	Level
2003	CSO	Any	Any	15≤YAS<20 YAS, 18<TAFMS	5	$15,000	Level
2003	CSO	Any	Any	15<YAS<22, 18<TAFMS	to 25 YAS	$15,000	Level
2003	CSO	Any	Any	>22 YAS	to 25 YAS	$10,000	Level
2003	ABM	Any	Any	<22 YAS, <O-6 Select	3	$10,000	Level
2003	ABM	Any	Any	<20 YAS	5	$15,000	Level
2003	ABM	Any	Any	<22 YAS	to 25 YAS	$15,000	Level
2003	ABM	Any	Any	>22 YAS	to 25 YAS	$10,000	Level

Table C.1—continued

Year	Rating	Platform	Category	Eligibility	Total Years	Pay per Year	Percentage of Total Amount That Is Available in First Year of Commitment
2004	Pilots	Any	Initial	<22 YAS, <O-6 Select	3	$15,000	50% or level
2004	Pilots	Any	Initial	<20 YAS	5	$25,000	50% or level, ≤$100,000
2004	Pilots	Any	Initial	<17 YAS	to 20 YAS	$25,000	50% or level, ≤$100,000
2004	Pilots	Any	Initial	<22 YAS	to 25 YAS	$25,000	50% or level, ≤$100,000
2004	Pilots	Any	Initial	>22 YAS	to 25 YAS	$15,000	50% or level, ≤$100,000
2004	Pilots	Any	Other	<20 YAS	5	$25,000	Level
2004	Pilots	Any	Other	<15 YAS	to 20 YAS	$25,000	Level
2004	CSO	Any	Initial	9≤YAS<20	5	$15,000	Level
2004	CSO	Any	Initial	9≤YAS<20	to 20 YAS	$15,000	Level
2004	CSO	Any	Other	9≤YAS<20, 18<TAFMS	5	$15,000	Level
2004	CSO	Any	Other	9≤YAS<20, 18<TAFMS	to 20 YAS	$15,000	Level
2004	ABM	Any	Initial	3≤YAS<20	5	$15,000	Level
2004	ABM	Any	Other	<20 YAS	5	$15,000	Level
2005	Pilots	Any	Initial	≥9 YAS	5	$25,000	50% or level, ≤$100,000
2005	CSO	Any	Initial	≥9 YAS	5	$15,000	Level
2005	ABM	Any	Initial	≥6 YAS	5	$15,000	Level
2006	Pilots	Any	Initial	≥9 YAS	5	$25,000	Level
2006	ABM	Any	Initial	≥6 YAS	5	$15,000	Level
2007	Pilots	Any	Initial	≥9 YAS	5	$25,000	Level
2007	ABM	Any	Initial	≥6 YAS	5	$15,000	Level
2008	Pilots	Any	Initial	≥9 YAS	5	$25,000	Level
2008	ABM	Any	Initial	≥6 YAS	5	$15,000	Level
2009	Pilots	Any	Initial	9≤YAS≤20	5	$25,000	Level
2009	ABM	Any	Initial	6≤YAS≤20	5	$15,000	Level
2009	Pilots	Any	Retirement-eligible	TAFMS>20, YAS≤22, <O-6 Select	3	$15,000	Level

Table C.1—continued

Year	Rating	Platform	Category	Eligibility	Total Years	Pay per Year	Percentage of Total Amount That Is Available in First Year of Commitment
2009	CSO	Any	Retirement-eligible	TAFMS>20, YAS≤22, <O-6 Select	3	$15,000	Level
2009	ABM	Any	Retirement-eligible	TAFMS>20, YAS≤22, <O-6 Select	3	$15,000	Level
2009	Pilots	Any	Retirement-eligible	TAFMS>20, YAS≤21, <O-6 Select	4	$15,000	Level
2009	CSO	Any	Retirement-eligible	TAFMS>20, YAS≤21, <O-6 Select	4	$15,000	Level
2009	ABM	Any	Retirement-eligible	TAFMS>20, YAS≤21, <O-6 Select	4	$15,000	Level
2009	Pilots	Any	Retirement-eligible	TAFMS>20, YAS≤20, <O-6 Select	5	$15,000	Level
2009	CSO	Any	Retirement-eligible	TAFMS>20, YAS≤20, <O-6 Select	5	$15,000	Level
2009	ABM	Any	Retirement-eligible	TAFMS>20, YAS≤20, <O-6 Select	5	$15,000	Level
2009	Pilots	Any	Uncommitted	TAFMS<15	3	$15,000	Level
2009	Pilots	Any	Uncommitted	TAFMS<15	4	$15,000	Level
2009	Pilots	Any	Uncommitted	TAFMS<15	5	$15,000	Level
2010	Pilots	Any	Initial	9≤YAS≤20	5	$25,000	Level
2010	ABM	Any	Initial	6≤YAS≤20	5	$15,000	Level
2010	Pilots	Any	Uncommitted	TAFMS≤15, YAS≤12, <O-6 Select	3	$15,000	Level
2010	CSO	12U	Uncommitted	TAFMS≤15, YAS≤12, <O-6 Select	3	$15,000	Level
2010	Pilots	Any	Uncommitted	TAFMS≤15, YAS≤12, <O-6 Select	4	$15,000	Level
2010	CSO	12U	Uncommitted	TAFMS≤15, YAS≤12, <O-6 Select	4	$15,000	Level
2010	Pilots	Any	Uncommitted	TAFMS≤15, YAS≤12, <O-6 Select	5	$15,000	Level

Table C.1—continued

Year	Rating	Platform	Category	Eligibility	Total Years	Pay per Year	Percentage of Total Amount That Is Available in First Year of Commitment
2010	CSO	12U	Uncommitted	TAFMS≤15, YAS≤12, <O-6 Select	5	$15,000	Level
2011	Pilots	Any	Initial	9≤YAS≤20	5	$25,000	Level
2011	Pilots	Any	Uncommitted	TAFMS≤15, YAS≤12, <O-6 Select	3	$15,000	Level
2011	CSO	12U	Uncommitted	TAFMS≤15, YAS≤12, <O-6 Select	3	$15,000	Level
2011	Pilots	Any	Uncommitted	TAFMS≤15, YAS≤12, <O-6 Select	4	$15,000	Level
2011	CSO	12U	Uncommitted	TAFMS≤15, YAS≤12, <O-6 Select	4	$15,000	Level
2011	Pilots	Any	Uncommitted	TAFMS≤15, YAS≤12, <O-6 Select	5	$15,000	Level
2011	CSO	12U	Uncommitted	TAFMS≤15, YAS≤12, <O-6 Select	5	$15,000	Level
2012	Pilots	Any	Initial	11≤YAS≤20	5	$25,000	Level
2012	Pilots	11U or 11F	Initial	11≤YAS≤20	5	$25,000	50% or level
2012	CSO	12F	Initial	6≤YAS≤20	5	$15,000	Level
2012	Pilots	Any	Uncommitted	TAFMS≤15, YAS≤12, <O-6 Select	3	$15,000	Level
2012	CSO	12U	Uncommitted	TAFMS≤15, YAS≤12, <O-6 Select	3	$15,000	Level
2012	Pilots	Any	Uncommitted	TAFMS≤15, YAS≤12, <O-6 Select	4	$15,000	Level
2012	CSO	12U	Uncommitted	TAFMS≤15, YAS≤12, <O-6 Select	4	$15,000	Level
2012	Pilots	Any	Uncommitted	TAFMS≤15, YAS≤12, <O-6 Select	5	$15,000	Level
2012	CSO	12U	Uncommitted	TAFMS≤15, YAS≤12, <O-6 Select	5	$15,000	Level
2013	Pilots	Any	Initial	11≤YAS≤20	5	$25,000	Level

Table C.1—continued

Year	Rating	Platform	Category	Eligibility	Total Years	Pay per Year	Percentage of Total Amount That Is Available in First Year of Commitment
2013	Pilots	11U or 11F/E	Initial	11≤YAS≤20	5	$25,000	50% or level
2013	Pilots	11F/E	Initial	6≤TAFMS≤15	to 20 YAS	$25,000	50% or level
2013	CSO	12F/E	Initial	YAS≤20	5	$15,000	Level
2013	Pilots	Any	Uncommitted	12≤TAFMS≤15, 11≤YAS, <O-6 Select	3	$15,000	Level
2013	CSO	12U	Uncommitted	12≤TAFMS≤15, 6≤YAS, <O-6 Select	3	$15,000	Level
2013	Pilots	Any	Uncommitted	11≤TAFMS≤15, 11≤YAS, <O-6 Select	4	$15,000	Level
2013	CSO	12U	Uncommitted	11≤TAFMS≤15, 6≤YAS, <O-6 Select	4	$15,000	Level
2013	Pilots	Any	Uncommitted	10≤TAFMS≤15, 11≤YAS, <O-6 Select	5	$15,000	Level
2013	CSO	12U	Uncommitted	10≤TAFMS≤15, 6≤YAS, <O-6 Select	5	$15,000	Level

NOTES: ABM = air battle manager; CSO = combat systems operator; TAFMS = total active federal military service.

APPENDIX D

Simulation Tables

Tables D.1 and D.2 show the full range of scenarios we considered, and from which we selected the scenarios shown in Tables 7.1 and 7.2 in the main text. Note that the net increase in civilian pilot wage is the difference between the real percentage increase in civilian pilot wage relative to the wage level in 2014 and the real percentage increase in RMC relative to the RMC level in 2014. Similarly, the net increase in civilian non-pilot wage is the difference between the real percentage increase in the civilian non-pilot wage relative to the wage level in 2014 and the real percentage increase in RMC relative to the RMC level in 2014. For example, if RMC is expected to grow by 4 percent (real) from 2014 to 2018, non-pilot pay by 8 percent (real), and pilot pay by 17 percent (real) over the same period, then the relative increases we simulate in our model are a 4-percent net increase in non-pilot pay and a 13-percent net increase in pilot pay. More generally, if the real growth in RMC is x percent, then the net increase in non-pilot pay is $8 - x$ percent and the net increase in pilot pay is $17 - x$ percent.

Table D.1
Simulated Percentage Change in Steady-State Force Size Caused by an Increase in the Probability of Being Hired by a Major Airline and/or an Increase in Civilian Opportunity Earnings (Three-Year, Five-Year, and Until-20-YAS Contracts)

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Overall Force Size	Change in Overall Force Size (Number of Personnel)	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS
2,900	40%	0%	0%	–4.7%	606	–3.3%	–11.2%
2,900	40%	0%	1%	–5.0%	645	–3.5%	–11.9%
2,900	40%	0%	2%	–5.2%	671	–3.6%	–12.4%
2,900	40%	0%	3%	–5.4%	697	–3.8%	–12.8%
2,900	40%	0%	4%	–5.6%	722	–3.9%	–13.4%
2,900	40%	0%	5%	–5.9%	761	–4.1%	–13.9%
2,900	40%	0%	6%	–6.1%	787	–4.3%	–14.5%
2,900	40%	0%	7%	–6.4%	826	–4.5%	–15.2%
2,900	40%	0%	8%	–6.6%	851	–4.6%	–15.8%
2,900	40%	0%	9%	–6.9%	890	–4.9%	–16.4%
2,900	40%	0%	10%	–7.3%	942	–5.1%	–17.3%
2,900	40%	0%	11%	–7.5%	968	–5.3%	–17.8%
2,900	40%	0%	12%	–7.8%	1,006	–5.4%	–18.3%
2,900	40%	0%	13%	–8.1%	1,045	–5.7%	–19.3%
2,900	40%	0%	14%	–8.5%	1,097	–5.9%	–20.2%
2,900	40%	0%	15%	–8.8%	1,135	–6.2%	–21.0%
2,900	40%	0%	16%	–9.2%	1,187	–6.4%	–21.9%
2,900	40%	0%	17%	–9.4%	1,213	–6.5%	–22.5%
2,900	40%	1%	0%	–5.0%	645	–3.4%	–12.3%
2,900	40%	1%	1%	–5.2%	671	–3.6%	–12.9%
2,900	40%	1%	2%	–5.4%	697	–3.7%	–13.3%
2,900	40%	1%	3%	–5.7%	735	–3.9%	–13.9%
2,900	40%	1%	4%	–5.9%	761	–4.0%	–14.4%
2,900	40%	1%	5%	–6.1%	787	–4.2%	–15.0%
2,900	40%	1%	6%	–6.4%	826	–4.4%	–15.6%
2,900	40%	1%	7%	–6.7%	864	–4.6%	–16.2%
2,900	40%	1%	8%	–6.9%	890	–4.8%	–16.8%
2,900	40%	1%	9%	–7.3%	942	–5.0%	–17.5%
2,900	40%	1%	10%	–7.5%	968	–5.2%	–18.2%

Table D.1—continued

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Overall Force Size	Change in Overall Force Size (Number of Personnel)	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS
2,900	40%	1%	11%	–7.8%	1,006	–5.4%	–18.8%
2,900	40%	1%	12%	–8.1%	1,045	–5.6%	–19.4%
2,900	40%	1%	13%	–8.4%	1,084	–5.8%	–20.4%
2,900	40%	1%	14%	–8.8%	1,135	–6.1%	–21.3%
2,900	40%	1%	15%	–9.1%	1,174	–6.3%	–22.1%
2,900	40%	1%	16%	–9.4%	1,213	–6.5%	–22.8%
2,900	40%	1%	17%	–9.7%	1,251	–6.7%	–23.4%
2,900	40%	2%	0%	–5.3%	684	–3.6%	–13.4%
2,900	40%	2%	1%	–5.5%	710	–3.7%	–13.9%
2,900	40%	2%	2%	–5.8%	748	–3.9%	–14.5%
2,900	40%	2%	3%	–6.0%	774	–4.0%	–15.0%
2,900	40%	2%	4%	–6.2%	800	–4.2%	–15.6%
2,900	40%	2%	5%	–6.4%	826	–4.3%	–16.1%
2,900	40%	2%	6%	–6.7%	864	–4.6%	–16.7%
2,900	40%	2%	7%	–7.0%	903	–4.7%	–17.2%
2,900	40%	2%	8%	–7.2%	929	–4.9%	–17.7%
2,900	40%	2%	9%	–7.6%	980	–5.2%	–18.5%
2,900	40%	2%	10%	–7.8%	1,006	–5.4%	–19.1%
2,900	40%	2%	11%	–8.1%	1,045	–5.6%	–19.7%
2,900	40%	2%	12%	–8.4%	1,084	–5.8%	–20.6%
2,900	40%	2%	13%	–8.8%	1,135	–6.0%	–21.5%
2,900	40%	2%	14%	–9.2%	1,187	–6.3%	–22.4%
2,900	40%	2%	15%	–9.4%	1,213	–6.5%	–23.1%
2,900	40%	2%	16%	–9.7%	1,251	–6.6%	–23.9%
2,900	40%	2%	17%	–10.0%	1,290	–6.8%	–24.6%
2,900	40%	3%	0%	–5.6%	722	–3.6%	–14.5%
2,900	40%	3%	1%	–5.8%	748	–3.8%	–15.0%
2,900	40%	3%	2%	–6.1%	787	–4.0%	–15.8%
2,900	40%	3%	3%	–6.3%	813	–4.2%	–16.3%
2,900	40%	3%	4%	–6.5%	839	–4.3%	–16.8%

Table D.1—continued

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Overall Force Size	Change in Overall Force Size (Number of Personnel)	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS
2,900	40%	3%	5%	–6.8%	877	–4.5%	–17.3%
2,900	40%	3%	6%	–7.0%	903	–4.7%	–17.9%
2,900	40%	3%	7%	–7.3%	942	–4.9%	–18.4%
2,900	40%	3%	8%	–7.7%	993	–5.1%	–19.2%
2,900	40%	3%	9%	–7.9%	1,019	–5.3%	–19.7%
2,900	40%	3%	10%	–8.2%	1,058	–5.5%	–20.4%
2,900	40%	3%	11%	–8.4%	1,084	–5.7%	–21.1%
2,900	40%	3%	12%	–8.8%	1,135	–5.9%	–22.0%
2,900	40%	3%	13%	–9.2%	1,187	–6.2%	–22.9%
2,900	40%	3%	14%	–9.5%	1,226	–6.4%	–23.7%
2,900	40%	3%	15%	–9.8%	1,264	–6.6%	–24.4%
2,900	40%	3%	16%	–10.1%	1,303	–6.8%	–25.1%
2,900	40%	3%	17%	–10.4%	1,342	–7.0%	–26.0%
2,900	40%	4%	0%	–5.9%	761	–3.8%	–15.5%
2,900	40%	4%	1%	–6.2%	800	–4.0%	–16.3%
2,900	40%	4%	2%	–6.4%	826	–4.1%	–16.8%
2,900	40%	4%	3%	–6.6%	851	–4.3%	–17.4%
2,900	40%	4%	4%	–6.9%	890	–4.4%	–18.0%
2,900	40%	4%	5%	–7.1%	916	–4.6%	–18.6%
2,900	40%	4%	6%	–7.4%	955	–4.8%	–19.1%
2,900	40%	4%	7%	–7.6%	980	–5.0%	–19.6%
2,900	40%	4%	8%	–8.0%	1,032	–5.3%	–20.5%
2,900	40%	4%	9%	–8.2%	1,058	–5.5%	–21.1%
2,900	40%	4%	10%	–8.5%	1,097	–5.6%	–21.6%
2,900	40%	4%	11%	–8.8%	1,135	–5.9%	–22.5%
2,900	40%	4%	12%	–9.2%	1,187	–6.1%	–23.5%
2,900	40%	4%	13%	–9.6%	1,238	–6.4%	–24.3%
2,900	40%	4%	14%	–9.9%	1,277	–6.6%	–25.0%
2,900	40%	4%	15%	–10.1%	1,303	–6.7%	–25.7%
2,900	40%	4%	16%	–10.5%	1,355	–7.0%	–26.5%

Table D.1—continued

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Overall Force Size	Change in Overall Force Size (Number of Personnel)	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS
2,900	40%	4%	17%	–10.7%	1,380	–7.2%	–27.1%
2,900	40%	5%	0%	–6.2%	800	–3.9%	–17.0%
2,900	40%	5%	1%	–6.5%	839	–4.1%	–17.6%
2,900	40%	5%	2%	–6.7%	864	–4.2%	–18.0%
2,900	40%	5%	3%	–6.9%	890	–4.4%	–18.6%
2,900	40%	5%	4%	–7.1%	916	–4.5%	–19.1%
2,900	40%	5%	5%	–7.4%	955	–4.8%	–19.7%
2,900	40%	5%	6%	–7.7%	993	–4.9%	–20.3%
2,900	40%	5%	7%	–8.0%	1,032	–5.2%	–20.9%
2,900	40%	5%	8%	–8.3%	1,071	–5.4%	–21.5%
2,900	40%	5%	9%	–8.5%	1,097	–5.6%	–22.2%
2,900	40%	5%	10%	–8.8%	1,135	–5.8%	–22.8%
2,900	40%	5%	11%	–9.1%	1,174	–6.0%	–23.6%
2,900	40%	5%	12%	–9.5%	1,226	–6.2%	–24.5%
2,900	40%	5%	13%	–9.9%	1,277	–6.5%	–25.4%
2,900	40%	5%	14%	–10.1%	1,303	–6.7%	–26.0%
2,900	40%	5%	15%	–10.4%	1,342	–6.9%	–26.6%
2,900	40%	5%	16%	–10.7%	1,380	–7.1%	–27.5%
2,900	40%	5%	17%	–11.0%	1,419	–7.3%	–28.0%
3,200	50%	0%	0%	–6.3%	813	–4.4%	–15.1%
3,200	50%	0%	1%	–6.6%	851	–4.7%	–15.8%
3,200	50%	0%	2%	–7.0%	903	–5.0%	–16.7%
3,200	50%	0%	3%	–7.4%	955	–5.2%	–17.5%
3,200	50%	0%	4%	–7.7%	993	–5.4%	–18.2%
3,200	50%	0%	5%	–8.1%	1,045	–5.7%	–19.2%
3,200	50%	0%	6%	–8.6%	1,109	–6.0%	–20.4%
3,200	50%	0%	7%	–9.0%	1,161	–6.3%	–21.6%
3,200	50%	0%	8%	–9.4%	1,213	–6.5%	–22.4%
3,200	50%	0%	9%	–9.8%	1,264	–6.8%	–23.4%
3,200	50%	0%	10%	–10.1%	1,303	–7.0%	–24.0%

Table D.1—continued

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Overall Force Size	Change in Overall Force Size (Number of Personnel)	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS
3,200	50%	0%	11%	–10.5%	1,355	–7.3%	–25.2%
3,200	50%	0%	12%	–10.9%	1,406	–7.6%	–26.2%
3,200	50%	0%	13%	–11.3%	1,458	–7.9%	–27.1%
3,200	50%	0%	14%	–11.7%	1,509	–8.1%	–28.0%
3,200	50%	0%	15%	–12.0%	1,548	–8.3%	–28.8%
3,200	50%	0%	16%	–12.4%	1,600	–8.6%	–29.7%
3,200	50%	0%	17%	–12.7%	1,638	–8.8%	–30.5%
3,200	50%	1%	0%	–6.6%	851	–4.5%	–15.9%
3,200	50%	1%	1%	–6.9%	890	–4.8%	–16.7%
3,200	50%	1%	2%	–7.3%	942	–5.1%	–17.7%
3,200	50%	1%	3%	–7.7%	993	–5.3%	–18.5%
3,200	50%	1%	4%	–8.0%	1,032	–5.5%	–19.2%
3,200	50%	1%	5%	–8.4%	1,084	–5.8%	–20.3%
3,200	50%	1%	6%	–8.8%	1,135	–6.1%	–21.4%
3,200	50%	1%	7%	–9.2%	1,187	–6.4%	–22.4%
3,200	50%	1%	8%	–9.6%	1,238	–6.6%	–23.2%
3,200	50%	1%	9%	–10.0%	1,290	–6.9%	–24.3%
3,200	50%	1%	10%	–10.3%	1,329	–7.1%	–25.0%
3,200	50%	1%	11%	–10.8%	1,393	–7.4%	–26.1%
3,200	50%	1%	12%	–11.1%	1,432	–7.7%	–27.0%
3,200	50%	1%	13%	–11.5%	1,484	–7.9%	–27.9%
3,200	50%	1%	14%	–11.8%	1,522	–8.2%	–28.6%
3,200	50%	1%	15%	–12.1%	1,561	–8.4%	–29.4%
3,200	50%	1%	16%	–12.5%	1,613	–8.7%	–30.3%
3,200	50%	1%	17%	–12.9%	1,664	–8.9%	–31.2%
3,200	50%	2%	0%	–6.8%	877	–4.6%	–16.9%
3,200	50%	2%	1%	–7.1%	916	–4.9%	–17.5%
3,200	50%	2%	2%	–7.5%	968	–5.2%	–18.4%
3,200	50%	2%	3%	–7.9%	1,019	–5.4%	–19.3%
3,200	50%	2%	4%	–8.3%	1,071	–5.7%	–20.2%

Table D.1—continued

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Overall Force Size	Change in Overall Force Size (Number of Personnel)	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS
3,200	50%	2%	5%	–8.6%	1,109	–5.9%	–21.1%
3,200	50%	2%	6%	–9.1%	1,174	–6.3%	–22.3%
3,200	50%	2%	7%	–9.5%	1,226	–6.5%	–23.2%
3,200	50%	2%	8%	–9.8%	1,264	–6.7%	–24.1%
3,200	50%	2%	9%	–10.3%	1,329	–7.0%	–25.2%
3,200	50%	2%	10%	–10.6%	1,367	–7.3%	–26.0%
3,200	50%	2%	11%	–11.0%	1,419	–7.5%	–27.0%
3,200	50%	2%	12%	–11.4%	1,471	–7.8%	–27.8%
3,200	50%	2%	13%	–11.7%	1,509	–8.0%	–28.6%
3,200	50%	2%	14%	–12.1%	1,561	–8.3%	–29.5%
3,200	50%	2%	15%	–12.4%	1,600	–8.5%	–30.2%
3,200	50%	2%	16%	–12.7%	1,638	–8.7%	–31.1%
3,200	50%	2%	17%	–13.2%	1,703	–9.0%	–32.3%
3,200	50%	3%	0%	–7.1%	916	–4.7%	–18.1%
3,200	50%	3%	1%	–7.5%	968	–5.0%	–18.7%
3,200	50%	3%	2%	–7.8%	1,006	–5.3%	–19.6%
3,200	50%	3%	3%	–8.2%	1,058	–5.5%	–20.5%
3,200	50%	3%	4%	–8.5%	1,097	–5.8%	–21.3%
3,200	50%	3%	5%	–9.0%	1,161	–6.0%	–22.4%
3,200	50%	3%	6%	–9.4%	1,213	–6.3%	–23.4%
3,200	50%	3%	7%	–9.8%	1,264	–6.6%	–24.3%
3,200	50%	3%	8%	–10.2%	1,316	–6.9%	–25.3%
3,200	50%	3%	9%	–10.6%	1,367	–7.1%	–26.3%
3,200	50%	3%	10%	–11.0%	1,419	–7.4%	–27.2%
3,200	50%	3%	11%	–11.3%	1,458	–7.6%	–28.0%
3,200	50%	3%	12%	–11.7%	1,509	–7.9%	–29.1%
3,200	50%	3%	13%	–12.0%	1,548	–8.1%	–29.8%
3,200	50%	3%	14%	–12.3%	1,587	–8.4%	–30.6%
3,200	50%	3%	15%	–12.6%	1,625	–8.6%	–31.3%
3,200	50%	3%	16%	–13.0%	1,677	–8.8%	–32.3%

Table D.1—continued

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Overall Force Size	Change in Overall Force Size (Number of Personnel)	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS
3,200	50%	3%	17%	–13.5%	1,742	–9.1%	–33.3%
3,200	50%	4%	0%	–7.4%	955	–4.8%	–19.2%
3,200	50%	4%	1%	–7.8%	1,006	–5.1%	–20.0%
3,200	50%	4%	2%	–8.1%	1,045	–5.4%	–20.7%
3,200	50%	4%	3%	–8.4%	1,084	–5.6%	–21.4%
3,200	50%	4%	4%	–8.8%	1,135	–5.9%	–22.5%
3,200	50%	4%	5%	–9.3%	1,200	–6.2%	–23.8%
3,200	50%	4%	6%	–9.8%	1,264	–6.5%	–24.7%
3,200	50%	4%	7%	–10.1%	1,303	–6.7%	–25.5%
3,200	50%	4%	8%	–10.5%	1,355	–7.0%	–26.6%
3,200	50%	4%	9%	–10.8%	1,393	–7.2%	–27.2%
3,200	50%	4%	10%	–11.2%	1,445	–7.5%	–28.3%
3,200	50%	4%	11%	–11.6%	1,496	–7.8%	–29.1%
3,200	50%	4%	12%	–11.9%	1,535	–8.0%	–30.0%
3,200	50%	4%	13%	–12.3%	1,587	–8.3%	–30.8%
3,200	50%	4%	14%	–12.6%	1,625	–8.5%	–31.7%
3,200	50%	4%	15%	–13.0%	1,677	–8.7%	–32.5%
3,200	50%	4%	16%	–13.3%	1,716	–9.0%	–33.3%
3,200	50%	4%	17%	–13.7%	1,767	–9.3%	–34.3%
3,200	50%	5%	0%	–7.7%	993	–4.9%	–20.3%
3,200	50%	5%	1%	–8.0%	1,032	–5.2%	–21.0%
3,200	50%	5%	2%	–8.4%	1,084	–5.5%	–21.7%
3,200	50%	5%	3%	–8.7%	1,122	–5.7%	–22.5%
3,200	50%	5%	4%	–9.1%	1,174	–6.0%	–23.5%
3,200	50%	5%	5%	–9.6%	1,238	–6.3%	–24.7%
3,200	50%	5%	6%	–10.0%	1,290	–6.6%	–25.6%
3,200	50%	5%	7%	–10.3%	1,329	–6.8%	–26.4%
3,200	50%	5%	8%	–10.7%	1,380	–7.1%	–27.3%
3,200	50%	5%	9%	–11.0%	1,419	–7.3%	–28.1%
3,200	50%	5%	10%	–11.5%	1,484	–7.6%	–29.2%

Table D.1—continued

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Overall Force Size	Change in Overall Force Size (Number of Personnel)	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS
3,200	50%	5%	11%	–11.8%	1,522	–7.9%	–30.1%
3,200	50%	5%	12%	–12.2%	1,574	–8.1%	–31.0%
3,200	50%	5%	13%	–12.5%	1,613	–8.3%	–31.7%
3,200	50%	5%	14%	–12.9%	1,664	–8.6%	–32.5%
3,200	50%	5%	15%	–13.2%	1,703	–8.8%	–33.4%
3,200	50%	5%	16%	–13.6%	1,754	–9.1%	–34.2%
3,200	50%	5%	17%	–14.0%	1,806	–9.4%	–35.2%
3,500	60%	0%	0%	–8.3%	1,071	–5.8%	–19.7%
3,500	60%	0%	1%	–8.8%	1,135	–6.2%	–21.0%
3,500	60%	0%	2%	–9.3%	1,200	–6.5%	–22.2%
3,500	60%	0%	3%	–9.8%	1,264	–6.8%	–23.4%
3,500	60%	0%	4%	–10.2%	1,316	–7.1%	–24.4%
3,500	60%	0%	5%	–10.7%	1,380	–7.5%	–25.6%
3,500	60%	0%	6%	–11.2%	1,445	–7.8%	–26.8%
3,500	60%	0%	7%	–11.6%	1,496	–8.0%	–27.8%
3,500	60%	0%	8%	–12.0%	1,548	–8.3%	–28.8%
3,500	60%	0%	9%	–12.4%	1,600	–8.6%	–29.8%
3,500	60%	0%	10%	–12.9%	1,664	–9.0%	–31.1%
3,500	60%	0%	11%	–13.4%	1,729	–9.3%	–32.3%
3,500	60%	0%	12%	–13.9%	1,793	–9.6%	–33.4%
3,500	60%	0%	13%	–14.3%	1,845	–9.9%	–34.4%
3,500	60%	0%	14%	–14.7%	1,896	–10.2%	–35.2%
3,500	60%	0%	15%	–15.1%	1,948	–10.5%	–36.4%
3,500	60%	0%	16%	–15.6%	2,012	–10.8%	–37.7%
3,500	60%	0%	17%	–16.0%	2,064	–11.1%	–38.5%
3,500	60%	1%	0%	–8.5%	1,097	–5.9%	–20.5%
3,500	60%	1%	1%	–9.0%	1,161	–6.2%	–21.8%
3,500	60%	1%	2%	–9.5%	1,226	–6.5%	–22.9%
3,500	60%	1%	3%	–10.0%	1,290	–6.9%	–24.1%
3,500	60%	1%	4%	–10.4%	1,342	–7.2%	–25.1%

Table D.1—continued

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Overall Force Size	Change in Overall Force Size (Number of Personnel)	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS
3,500	60%	1%	5%	–10.9%	1,406	–7.5%	–26.4%
3,500	60%	1%	6%	–11.3%	1,458	–7.8%	–27.4%
3,500	60%	1%	7%	–11.7%	1,509	–8.1%	–28.3%
3,500	60%	1%	8%	–12.1%	1,561	–8.4%	–29.3%
3,500	60%	1%	9%	–12.6%	1,625	–8.7%	–30.3%
3,500	60%	1%	10%	–13.0%	1,677	–9.0%	–31.5%
3,500	60%	1%	11%	–13.5%	1,742	–9.4%	–32.7%
3,500	60%	1%	12%	–14.0%	1,806	–9.7%	–33.9%
3,500	60%	1%	13%	–14.5%	1,871	–10.0%	–35.0%
3,500	60%	1%	14%	–14.8%	1,909	–10.2%	–35.7%
3,500	60%	1%	15%	–15.3%	1,974	–10.5%	–36.9%
3,500	60%	1%	16%	–15.7%	2,025	–10.9%	–38.1%
3,500	60%	1%	17%	–16.1%	2,077	–11.1%	–39.1%
3,500	60%	2%	0%	–8.7%	1,122	–6.0%	–21.2%
3,500	60%	2%	1%	–9.3%	1,200	–6.4%	–22.7%
3,500	60%	2%	2%	–9.7%	1,251	–6.6%	–23.6%
3,500	60%	2%	3%	–10.2%	1,316	–7.0%	–25.0%
3,500	60%	2%	4%	–10.6%	1,367	–7.2%	–25.9%
3,500	60%	2%	5%	–11.0%	1,419	–7.6%	–27.0%
3,500	60%	2%	6%	–11.5%	1,484	–7.9%	–28.1%
3,500	60%	2%	7%	–11.9%	1,535	–8.1%	–29.1%
3,500	60%	2%	8%	–12.3%	1,587	–8.5%	–30.1%
3,500	60%	2%	9%	–12.7%	1,638	–8.7%	–31.0%
3,500	60%	2%	10%	–13.2%	1,703	–9.1%	–32.3%
3,500	60%	2%	11%	–13.7%	1,767	–9.4%	–33.6%
3,500	60%	2%	12%	–14.2%	1,832	–9.8%	–34.7%
3,500	60%	2%	13%	–14.7%	1,896	–10.1%	–35.9%
3,500	60%	2%	14%	–15.0%	1,935	–10.3%	–36.6%
3,500	60%	2%	15%	–15.5%	2,000	–10.6%	–37.7%
3,500	60%	2%	16%	–15.9%	2,051	–10.9%	–38.9%

Table D.1—continued

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Overall Force Size	Change in Overall Force Size (Number of Personnel)	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS
3,500	60%	2%	17%	–16.3%	2,103	–11.2%	–39.9%
3,500	60%	3%	0%	–9.0%	1,161	–6.0%	–22.3%
3,500	60%	3%	1%	–9.5%	1,226	–6.4%	–23.7%
3,500	60%	3%	2%	–9.9%	1,277	–6.7%	–24.7%
3,500	60%	3%	3%	–10.4%	1,342	–7.0%	–25.9%
3,500	60%	3%	4%	–10.9%	1,406	–7.3%	–27.0%
3,500	60%	3%	5%	–11.3%	1,458	–7.6%	–28.0%
3,500	60%	3%	6%	–11.7%	1,509	–7.9%	–29.2%
3,500	60%	3%	7%	–12.1%	1,561	–8.2%	–30.1%
3,500	60%	3%	8%	–12.6%	1,625	–8.5%	–31.1%
3,500	60%	3%	9%	–13.0%	1,677	–8.8%	–32.1%
3,500	60%	3%	10%	–13.5%	1,742	–9.1%	–33.2%
3,500	60%	3%	11%	–14.0%	1,806	–9.5%	–34.6%
3,500	60%	3%	12%	–14.4%	1,858	–9.8%	–35.6%
3,500	60%	3%	13%	–14.8%	1,909	–10.1%	–36.6%
3,500	60%	3%	14%	–15.2%	1,961	–10.4%	–37.5%
3,500	60%	3%	15%	–15.7%	2,025	–10.7%	–38.7%
3,500	60%	3%	16%	–16.1%	2,077	–11.0%	–39.9%
3,500	60%	3%	17%	–16.5%	2,129	–11.3%	–40.8%
3,500	60%	4%	0%	–9.2%	1,187	–6.1%	–23.4%
3,500	60%	4%	1%	–9.8%	1,264	–6.5%	–24.7%
3,500	60%	4%	2%	–10.2%	1,316	–6.8%	–25.7%
3,500	60%	4%	3%	–10.6%	1,367	–7.1%	–26.9%
3,500	60%	4%	4%	–11.1%	1,432	–7.4%	–28.0%
3,500	60%	4%	5%	–11.5%	1,484	–7.7%	–28.9%
3,500	60%	4%	6%	–11.9%	1,535	–8.0%	–30.0%
3,500	60%	4%	7%	–12.4%	1,600	–8.3%	–31.0%
3,500	60%	4%	8%	–12.8%	1,651	–8.6%	–32.0%
3,500	60%	4%	9%	–13.2%	1,703	–8.9%	–33.0%
3,500	60%	4%	10%	–13.7%	1,767	–9.2%	–34.1%

Table D.1—continued

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Overall Force Size	Change in Overall Force Size (Number of Personnel)	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS
3,500	60%	4%	11%	–14.2%	1,832	–9.6%	–35.3%
3,500	60%	4%	12%	–14.6%	1,883	–9.9%	–36.4%
3,500	60%	4%	13%	–15.0%	1,935	–10.2%	–37.4%
3,500	60%	4%	14%	–15.4%	1,987	–10.4%	–38.3%
3,500	60%	4%	15%	–15.9%	2,051	–10.7%	–39.5%
3,500	60%	4%	16%	–16.3%	2,103	–11.0%	–40.7%
3,500	60%	4%	17%	–16.7%	2,154	–11.3%	–41.6%
3,500	60%	5%	0%	–9.4%	1,213	–6.2%	–24.2%
3,500	60%	5%	1%	–9.9%	1,277	–6.6%	–25.5%
3,500	60%	5%	2%	–10.3%	1,329	–6.8%	–26.5%
3,500	60%	5%	3%	–10.8%	1,393	–7.2%	–27.7%
3,500	60%	5%	4%	–11.3%	1,458	–7.5%	–28.8%
3,500	60%	5%	5%	–11.7%	1,509	–7.8%	–29.8%
3,500	60%	5%	6%	–12.1%	1,561	–8.1%	–30.8%
3,500	60%	5%	7%	–12.6%	1,625	–8.4%	–31.8%
3,500	60%	5%	8%	–13.0%	1,677	–8.7%	–32.8%
3,500	60%	5%	9%	–13.4%	1,729	–8.9%	–33.7%
3,500	60%	5%	10%	–13.9%	1,793	–9.3%	–35.0%
3,500	60%	5%	11%	–14.4%	1,858	–9.6%	–36.1%
3,500	60%	5%	12%	–14.8%	1,909	–9.9%	–37.2%
3,500	60%	5%	13%	–15.2%	1,961	–10.2%	–38.2%
3,500	60%	5%	14%	–15.6%	2,012	–10.5%	–39.0%
3,500	60%	5%	15%	–16.1%	2,077	–10.8%	–40.3%
3,500	60%	5%	16%	–16.5%	2,129	–11.1%	–41.3%
3,500	60%	5%	17%	–16.9%	2,180	–11.4%	–42.2%
3,800	70%	0%	0%	–10.5%	1,355	–7.4%	–25.2%
3,800	70%	0%	1%	–11.0%	1,419	–7.7%	–26.4%
3,800	70%	0%	2%	–11.5%	1,484	–8.0%	–27.5%
3,800	70%	0%	3%	–12.0%	1,548	–8.4%	–28.8%
3,800	70%	0%	4%	–12.5%	1,613	–8.7%	–30.0%

Table D.1—continued

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Overall Force Size	Change in Overall Force Size (Number of Personnel)	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS
3,800	70%	0%	5%	–13.1%	1,690	–9.1%	–31.5%
3,800	70%	0%	6%	–13.7%	1,767	–9.5%	–32.8%
3,800	70%	0%	7%	–14.2%	1,832	–9.9%	–34.1%
3,800	70%	0%	8%	–14.6%	1,883	–10.2%	–35.1%
3,800	70%	0%	9%	–15.1%	1,948	–10.5%	–36.4%
3,800	70%	0%	10%	–15.7%	2,025	–10.9%	–37.9%
3,800	70%	0%	11%	–16.1%	2,077	–11.2%	–38.8%
3,800	70%	0%	12%	–16.7%	2,154	–11.6%	–40.3%
3,800	70%	0%	13%	–17.2%	2,219	–12.0%	–41.4%
3,800	70%	0%	14%	–17.7%	2,283	–12.3%	–42.6%
3,800	70%	0%	15%	–18.2%	2,348	–12.6%	–43.8%
3,800	70%	0%	16%	–18.8%	2,425	–13.0%	–45.2%
3,800	70%	0%	17%	–19.2%	2,477	–13.3%	–46.4%
3,800	70%	1%	0%	–10.6%	1,367	–7.4%	–25.7%
3,800	70%	1%	1%	–11.1%	1,432	–7.7%	–26.9%
3,800	70%	1%	2%	–11.6%	1,496	–8.0%	–28.1%
3,800	70%	1%	3%	–12.1%	1,561	–8.4%	–29.2%
3,800	70%	1%	4%	–12.6%	1,625	–8.7%	–30.4%
3,800	70%	1%	5%	–13.2%	1,703	–9.1%	–31.8%
3,800	70%	1%	6%	–13.8%	1,780	–9.5%	–33.3%
3,800	70%	1%	7%	–14.3%	1,845	–9.9%	–34.5%
3,800	70%	1%	8%	–14.7%	1,896	–10.2%	–35.5%
3,800	70%	1%	9%	–15.2%	1,961	–10.5%	–36.7%
3,800	70%	1%	10%	–15.8%	2,038	–10.9%	–38.2%
3,800	70%	1%	11%	–16.3%	2,103	–11.2%	–39.3%
3,800	70%	1%	12%	–16.9%	2,180	–11.7%	–40.7%
3,800	70%	1%	13%	–17.3%	2,232	–12.0%	–41.8%
3,800	70%	1%	14%	–17.8%	2,296	–12.3%	–42.9%
3,800	70%	1%	15%	–18.2%	2,348	–12.6%	–44.1%
3,800	70%	1%	16%	–18.8%	2,425	–13.0%	–45.5%

Table D.1—continued

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Overall Force Size	Change in Overall Force Size (Number of Personnel)	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS
3,800	70%	1%	17%	–19.3%	2,490	–13.3%	–46.7%
3,800	70%	2%	0%	–10.8%	1,393	–7.4%	–26.3%
3,800	70%	2%	1%	–11.2%	1,445	–7.7%	–27.5%
3,800	70%	2%	2%	–11.7%	1,509	–8.0%	–28.8%
3,800	70%	2%	3%	–12.2%	1,574	–8.4%	–29.8%
3,800	70%	2%	4%	–12.7%	1,638	–8.8%	–31.1%
3,800	70%	2%	5%	–13.3%	1,716	–9.1%	–32.5%
3,800	70%	2%	6%	–13.9%	1,793	–9.5%	–33.9%
3,800	70%	2%	7%	–14.4%	1,858	–9.9%	–35.3%
3,800	70%	2%	8%	–14.8%	1,909	–10.2%	–36.2%
3,800	70%	2%	9%	–15.3%	1,974	–10.5%	–37.4%
3,800	70%	2%	10%	–15.9%	2,051	–10.9%	–38.9%
3,800	70%	2%	11%	–16.4%	2,116	–11.3%	–40.0%
3,800	70%	2%	12%	–17.0%	2,193	–11.7%	–41.5%
3,800	70%	2%	13%	–17.5%	2,258	–12.0%	–42.6%
3,800	70%	2%	14%	–17.9%	2,309	–12.3%	–43.8%
3,800	70%	2%	15%	–18.4%	2,374	–12.6%	–44.9%
3,800	70%	2%	16%	–19.0%	2,451	–13.0%	–46.3%
3,800	70%	2%	17%	–19.4%	2,503	–13.4%	–47.4%
3,800	70%	3%	0%	–11.0%	1,419	–7.4%	–27.2%
3,800	70%	3%	1%	–11.4%	1,471	–7.7%	–28.4%
3,800	70%	3%	2%	–11.9%	1,535	–8.1%	–29.6%
3,800	70%	3%	3%	–12.4%	1,600	–8.4%	–30.7%
3,800	70%	3%	4%	–12.9%	1,664	–8.7%	–31.9%
3,800	70%	3%	5%	–13.5%	1,742	–9.2%	–33.3%
3,800	70%	3%	6%	–14.0%	1,806	–9.5%	–34.7%
3,800	70%	3%	7%	–14.6%	1,883	–9.9%	–36.0%
3,800	70%	3%	8%	–15.0%	1,935	–10.2%	–36.9%
3,800	70%	3%	9%	–15.5%	2,000	–10.6%	–38.1%
3,800	70%	3%	10%	–16.1%	2,077	–10.9%	–39.6%

Table D.1—continued

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Overall Force Size	Change in Overall Force Size (Number of Personnel)	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS
3,800	70%	3%	11%	–16.5%	2,129	–11.3%	–40.7%
3,800	70%	3%	12%	–17.1%	2,206	–11.7%	–42.1%
3,800	70%	3%	13%	–17.6%	2,270	–12.0%	–43.2%
3,800	70%	3%	14%	–18.0%	2,322	–12.3%	–44.3%
3,800	70%	3%	15%	–18.5%	2,387	–12.7%	–45.6%
3,800	70%	3%	16%	–19.1%	2,464	–13.0%	–46.8%
3,800	70%	3%	17%	–19.5%	2,516	–13.4%	–47.8%
3,800	70%	4%	0%	–11.1%	1,432	–7.4%	–28.0%
3,800	70%	4%	1%	–11.6%	1,496	–7.8%	–29.2%
3,800	70%	4%	2%	–12.1%	1,561	–8.1%	–30.4%
3,800	70%	4%	3%	–12.6%	1,625	–8.5%	–31.5%
3,800	70%	4%	4%	–13.1%	1,690	–8.8%	–32.7%
3,800	70%	4%	5%	–13.6%	1,754	–9.2%	–34.0%
3,800	70%	4%	6%	–14.2%	1,832	–9.6%	–35.3%
3,800	70%	4%	7%	–14.7%	1,896	–9.9%	–36.6%
3,800	70%	4%	8%	–15.2%	1,961	–10.3%	–37.6%
3,800	70%	4%	9%	–15.6%	2,012	–10.6%	–38.8%
3,800	70%	4%	10%	–16.2%	2,090	–10.9%	–40.3%
3,800	70%	4%	11%	–16.7%	2,154	–11.3%	–41.4%
3,800	70%	4%	12%	–17.3%	2,232	–11.7%	–42.8%
3,800	70%	4%	13%	–17.7%	2,283	–12.1%	–43.7%
3,800	70%	4%	14%	–18.2%	2,348	–12.4%	–45.0%
3,800	70%	4%	15%	–18.6%	2,399	–12.7%	–46.0%
3,800	70%	4%	16%	–19.2%	2,477	–13.1%	–47.4%
3,800	70%	4%	17%	–19.7%	2,541	–13.4%	–48.5%
3,800	70%	5%	0%	–11.2%	1,445	–7.5%	–28.6%
3,800	70%	5%	1%	–11.8%	1,522	–7.8%	–29.9%
3,800	70%	5%	2%	–12.3%	1,587	–8.2%	–31.2%
3,800	70%	5%	3%	–12.7%	1,638	–8.5%	–32.2%
3,800	70%	5%	4%	–13.2%	1,703	–8.8%	–33.3%

Table D.1—continued

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Overall Force Size	Change in Overall Force Size (Number of Personnel)	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS
3,800	70%	5%	5%	–13.8%	1,780	–9.2%	–34.7%
3,800	70%	5%	6%	–14.3%	1,845	–9.6%	–35.9%
3,800	70%	5%	7%	–14.8%	1,909	–10.0%	–37.2%
3,800	70%	5%	8%	–15.3%	1,974	–10.3%	–38.2%
3,800	70%	5%	9%	–15.8%	2,038	–10.6%	–39.4%
3,800	70%	5%	10%	–16.3%	2,103	–11.0%	–40.9%
3,800	70%	5%	11%	–16.8%	2,167	–11.3%	–42.0%
3,800	70%	5%	12%	–17.4%	2,245	–11.7%	–43.2%
3,800	70%	5%	13%	–17.8%	2,296	–12.1%	–44.2%
3,800	70%	5%	14%	–18.3%	2,361	–12.4%	–45.3%
3,800	70%	5%	15%	–18.7%	2,412	–12.7%	–46.5%
3,800	70%	5%	16%	–19.3%	2,490	–13.1%	–47.8%
3,800	70%	5%	17%	–19.7%	2,541	–13.4%	–48.9%

Table D.2
Simulated Percentage Increase in ARP Needed to Compensate for an Increase in the Civilian Pilot Wage and Hiring Probability, Holding Force Size Constant

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS	Percentage Increase in ARP	Estimated ARP Budget Increase (in millions of 2015 dollars)
2,900	40%	0%	1%	–1.3%	6.2%	37%	24
2,900	40%	0%	2%	–1.4%	6.4%	40%	26
2,900	40%	0%	3%	–1.5%	6.8%	41%	26
2,900	40%	0%	4%	–1.5%	7.1%	43%	28
2,900	40%	0%	5%	–1.6%	7.4%	45%	29
2,900	40%	0%	6%	–1.7%	7.7%	47%	30
2,900	40%	0%	7%	–1.7%	8.0%	49%	32
2,900	40%	0%	8%	–1.8%	8.2%	52%	33
2,900	40%	0%	9%	–1.9%	8.5%	54%	35
2,900	40%	0%	10%	–1.9%	8.9%	56%	36
2,900	40%	0%	11%	–2.0%	9.3%	57%	37
2,900	40%	0%	12%	–2.1%	9.5%	59%	38
2,900	40%	0%	13%	–2.1%	9.8%	62%	40
2,900	40%	0%	14%	–2.2%	10.1%	64%	41
2,900	40%	0%	15%	–2.3%	10.4%	66%	43
2,900	40%	0%	16%	–2.3%	10.7%	68%	44
2,900	40%	0%	17%	–2.4%	11.0%	70%	45
2,900	40%	1%	0%	–1.2%	6.2%	38%	24
2,900	40%	1%	1%	–1.3%	6.2%	40%	26
2,900	40%	1%	2%	–1.4%	6.5%	42%	27
2,900	40%	1%	3%	–1.5%	6.8%	44%	28
2,900	40%	1%	4%	–1.5%	7.1%	46%	30
2,900	40%	1%	5%	–1.6%	7.3%	47%	30
2,900	40%	1%	6%	–1.7%	7.7%	49%	32
2,900	40%	1%	7%	–1.7%	8.0%	51%	33
2,900	40%	1%	8%	–1.8%	8.2%	54%	35
2,900	40%	1%	9%	–1.9%	8.6%	56%	36
2,900	40%	1%	10%	–1.9%	8.9%	58%	37
2,900	40%	1%	11%	–2.0%	9.2%	60%	39

Table D.2—continued

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS	Percentage Increase in ARP	Estimated ARP Budget Increase (in millions of 2015 dollars)
2,900	40%	1%	12%	–2.1%	9.5%	62%	40
2,900	40%	1%	13%	–2.1%	9.8%	64%	41
2,900	40%	1%	14%	–2.2%	10.0%	66%	43
2,900	40%	1%	15%	–2.3%	10.4%	69%	44
2,900	40%	1%	16%	–2.3%	10.5%	71%	46
2,900	40%	1%	17%	–2.4%	10.9%	73%	47
2,900	40%	2%	0%	–1.3%	5.8%	41%	26
2,900	40%	2%	1%	–1.3%	6.1%	42%	27
2,900	40%	2%	2%	–1.4%	6.4%	44%	28
2,900	40%	2%	3%	–1.5%	6.8%	46%	30
2,900	40%	2%	4%	–1.5%	7.0%	48%	31
2,900	40%	2%	5%	–1.6%	7.3%	50%	32
2,900	40%	2%	6%	–1.7%	7.7%	52%	33
2,900	40%	2%	7%	–1.7%	7.9%	54%	35
2,900	40%	2%	8%	–1.8%	8.2%	57%	37
2,900	40%	2%	9%	–1.9%	8.5%	59%	38
2,900	40%	2%	10%	–1.9%	8.9%	60%	39
2,900	40%	2%	11%	–2.0%	9.5%	63%	41
2,900	40%	2%	12%	–2.1%	9.5%	65%	42
2,900	40%	2%	13%	–2.1%	9.7%	66%	43
2,900	40%	2%	14%	–2.2%	10.0%	69%	44
2,900	40%	2%	15%	–2.2%	10.3%	71%	46
2,900	40%	2%	16%	–2.3%	10.6%	73%	47
2,900	40%	2%	17%	–2.3%	10.8%	76%	49
2,900	40%	3%	0%	–1.3%	5.8%	43%	28
2,900	40%	3%	1%	–1.3%	6.1%	45%	29
2,900	40%	3%	2%	–1.4%	6.5%	47%	30
2,900	40%	3%	3%	–1.5%	6.8%	49%	32
2,900	40%	3%	4%	–1.5%	7.1%	51%	33
2,900	40%	3%	5%	–1.6%	7.3%	53%	34

Table D.2—continued

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS	Percentage Increase in ARP	Estimated ARP Budget Increase (in millions of 2015 dollars)
2,900	40%	3%	6%	–1.7%	7.6%	54%	35
2,900	40%	3%	7%	–1.7%	7.9%	57%	37
2,900	40%	3%	8%	–1.8%	8.2%	59%	38
2,900	40%	3%	9%	–1.9%	8.5%	61%	39
2,900	40%	3%	10%	–1.9%	8.9%	63%	41
2,900	40%	3%	11%	–2.0%	9.1%	65%	42
2,900	40%	3%	12%	–2.0%	9.4%	67%	43
2,900	40%	3%	13%	–2.1%	9.7%	69%	44
2,900	40%	3%	14%	–2.2%	10.0%	71%	46
2,900	40%	3%	15%	–2.2%	10.3%	74%	48
2,900	40%	3%	16%	–2.3%	10.5%	76%	49
2,900	40%	3%	17%	–2.3%	10.7%	78%	50
2,900	40%	4%	0%	–1.3%	5.8%	46%	30
2,900	40%	4%	1%	–1.3%	6.2%	48%	31
2,900	40%	4%	2%	–1.4%	6.5%	50%	32
2,900	40%	4%	3%	–1.5%	6.7%	52%	33
2,900	40%	4%	4%	–1.5%	7.0%	53%	34
2,900	40%	4%	5%	–1.6%	7.3%	55%	35
2,900	40%	4%	6%	–1.6%	7.5%	57%	37
2,900	40%	4%	7%	–1.7%	7.9%	59%	38
2,900	40%	4%	8%	–1.8%	8.2%	62%	40
2,900	40%	4%	9%	–1.9%	8.5%	64%	41
2,900	40%	4%	10%	–1.9%	8.8%	66%	43
2,900	40%	4%	11%	–2.0%	9.1%	68%	44
2,900	40%	4%	12%	–2.0%	9.4%	70%	45
2,900	40%	4%	13%	–2.1%	9.7%	72%	46
2,900	40%	4%	14%	–2.2%	10.0%	74%	48
2,900	40%	4%	15%	–2.2%	10.2%	76%	49
2,900	40%	4%	16%	–2.3%	10.5%	79%	51
2,900	40%	4%	17%	–2.3%	10.7%	81%	52

Table D.2—continued

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS	Percentage Increase in ARP	Estimated ARP Budget Increase (in millions of 2015 dollars)
2,900	40%	5%	0%	–1.3%	5.8%	48%	31
2,900	40%	5%	1%	–1.3%	6.2%	51%	33
2,900	40%	5%	2%	–1.4%	6.5%	52%	33
2,900	40%	5%	3%	–1.5%	6.8%	54%	35
2,900	40%	5%	4%	–1.5%	7.1%	56%	36
2,900	40%	5%	5%	–1.6%	7.4%	58%	37
2,900	40%	5%	6%	–1.7%	7.6%	60%	39
2,900	40%	5%	7%	–1.7%	7.9%	62%	40
2,900	40%	5%	8%	–1.8%	8.1%	64%	41
2,900	40%	5%	9%	–1.8%	8.5%	67%	43
2,900	40%	5%	10%	–1.9%	8.9%	69%	44
2,900	40%	5%	11%	–2.0%	9.1%	71%	46
2,900	40%	5%	12%	–2.0%	9.4%	73%	47
2,900	40%	5%	13%	–2.1%	9.7%	75%	48
2,900	40%	5%	14%	–2.2%	10.0%	77%	50
2,900	40%	5%	15%	–2.2%	10.2%	79%	51
2,900	40%	5%	16%	–2.3%	10.5%	82%	53
2,900	40%	5%	17%	–2.3%	10.7%	84%	54
3,200	50%	0%	1%	–1.8%	8.2%	52%	33
3,200	50%	0%	2%	–1.9%	8.7%	54%	35
3,200	50%	0%	3%	–2.0%	9.1%	57%	37
3,200	50%	0%	4%	–2.1%	9.5%	59%	38
3,200	50%	0%	5%	–2.1%	9.7%	62%	40
3,200	50%	0%	6%	–2.2%	10.2%	64%	41
3,200	50%	0%	7%	–2.3%	10.6%	67%	43
3,200	50%	0%	8%	–2.4%	10.9%	70%	45
3,200	50%	0%	9%	–2.4%	11.2%	72%	46
3,200	50%	0%	10%	–2.5%	11.6%	76%	49
3,200	50%	0%	11%	–2.6%	11.9%	79%	51
3,200	50%	0%	12%	–2.6%	12.1%	82%	53

Table D.2—continued

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS	Percentage Increase in ARP	Estimated ARP Budget Increase (in millions of 2015 dollars)
3,200	50%	0%	13%	–2.7%	12.3%	85%	55
3,200	50%	0%	14%	–2.7%	12.6%	89%	57
3,200	50%	0%	15%	–2.8%	12.8%	91%	59
3,200	50%	0%	16%	–2.8%	13.0%	95%	61
3,200	50%	0%	17%	–2.8%	13.1%	98%	63
3,200	50%	1%	0%	–1.7%	7.9%	50%	32
3,200	50%	1%	1%	–1.8%	8.2%	54%	35
3,200	50%	1%	2%	–1.9%	8.6%	56%	36
3,200	50%	1%	3%	–2.0%	9.1%	59%	38
3,200	50%	1%	4%	–2.1%	9.4%	61%	39
3,200	50%	1%	5%	–2.1%	9.7%	64%	41
3,200	50%	1%	6%	–2.2%	10.1%	66%	43
3,200	50%	1%	7%	–2.3%	10.5%	69%	44
3,200	50%	1%	8%	–2.3%	10.8%	73%	47
3,200	50%	1%	9%	–2.4%	11.1%	75%	48
3,200	50%	1%	10%	–2.5%	11.5%	78%	50
3,200	50%	1%	11%	–2.6%	11.8%	81%	52
3,200	50%	1%	12%	–2.6%	12.0%	84%	54
3,200	50%	1%	13%	–2.7%	12.2%	87%	56
3,200	50%	1%	14%	–2.7%	12.5%	91%	59
3,200	50%	1%	15%	–2.8%	12.8%	94%	61
3,200	50%	1%	16%	–2.8%	12.9%	97%	62
3,200	50%	1%	17%	–2.8%	13.0%	101%	65
3,200	50%	2%	0%	–1.7%	7.8%	53%	34
3,200	50%	2%	1%	–1.8%	8.2%	56%	36
3,200	50%	2%	2%	–1.9%	8.6%	59%	38
3,200	50%	2%	3%	–2.0%	9.0%	61%	39
3,200	50%	2%	4%	–2.0%	9.3%	63%	41
3,200	50%	2%	5%	–2.1%	9.8%	66%	43
3,200	50%	2%	6%	–2.2%	10.0%	69%	44

Table D.2—continued

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS	Percentage Increase in ARP	Estimated ARP Budget Increase (in millions of 2015 dollars)
3,200	50%	2%	7%	–2.3%	10.4%	71%	46
3,200	50%	2%	8%	–2.3%	10.7%	75%	48
3,200	50%	2%	9%	–2.4%	10.9%	77%	50
3,200	50%	2%	10%	–2.5%	11.3%	80%	52
3,200	50%	2%	11%	–2.5%	11.6%	84%	54
3,200	50%	2%	12%	–2.6%	11.9%	87%	56
3,200	50%	2%	13%	–2.6%	12.1%	90%	58
3,200	50%	2%	14%	–2.7%	12.4%	93%	60
3,200	50%	2%	15%	–2.7%	12.6%	96%	62
3,200	50%	2%	16%	–2.8%	12.8%	100%	64
3,200	50%	2%	17%	–2.8%	13.0%	103%	66
3,200	50%	3%	0%	–1.7%	7.8%	55%	35
3,200	50%	3%	1%	–1.7%	8.0%	58%	37
3,200	50%	3%	2%	–1.8%	8.4%	61%	39
3,200	50%	3%	3%	–1.9%	8.9%	63%	41
3,200	50%	3%	4%	–2.0%	9.2%	66%	43
3,200	50%	3%	5%	–2.1%	9.6%	68%	44
3,200	50%	3%	6%	–2.2%	9.9%	71%	46
3,200	50%	3%	7%	–2.2%	10.3%	74%	48
3,200	50%	3%	8%	–2.3%	10.6%	77%	50
3,200	50%	3%	9%	–2.4%	10.8%	79%	51
3,200	50%	3%	10%	–2.4%	11.1%	82%	53
3,200	50%	3%	11%	–2.5%	11.5%	86%	55
3,200	50%	3%	12%	–2.5%	11.8%	89%	57
3,200	50%	3%	13%	–2.6%	12.0%	92%	59
3,200	50%	3%	14%	–2.7%	12.1%	95%	61
3,200	50%	3%	15%	–2.7%	12.4%	99%	64
3,200	50%	3%	16%	–2.7%	12.6%	102%	66
3,200	50%	3%	17%	–2.8%	12.8%	105%	68
3,200	50%	4%	0%	–1.7%	7.6%	57%	37

Table D.2—continued

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS	Percentage Increase in ARP	Estimated ARP Budget Increase (in millions of 2015 dollars)
3,200	50%	4%	1%	–1.7%	8.0%	60%	39
3,200	50%	4%	2%	–1.8%	8.4%	63%	41
3,200	50%	4%	3%	–1.9%	8.8%	65%	42
3,200	50%	4%	4%	–2.0%	9.2%	68%	44
3,200	50%	4%	5%	–2.1%	9.6%	71%	46
3,200	50%	4%	6%	–2.2%	9.9%	74%	48
3,200	50%	4%	7%	–2.2%	10.2%	76%	49
3,200	50%	4%	8%	–2.3%	10.5%	79%	51
3,200	50%	4%	9%	–2.3%	10.8%	81%	52
3,200	50%	4%	10%	–2.4%	11.0%	85%	55
3,200	50%	4%	11%	–2.5%	11.4%	88%	57
3,200	50%	4%	12%	–2.5%	11.6%	91%	59
3,200	50%	4%	13%	–2.6%	11.9%	94%	61
3,200	50%	4%	14%	–2.6%	12.1%	98%	63
3,200	50%	4%	15%	–2.7%	12.4%	101%	65
3,200	50%	4%	16%	–2.7%	12.5%	105%	68
3,200	50%	4%	17%	–2.8%	12.7%	108%	70
3,200	50%	5%	0%	–1.6%	7.6%	59%	38
3,200	50%	5%	1%	–1.7%	7.9%	63%	41
3,200	50%	5%	2%	–1.8%	8.3%	65%	42
3,200	50%	5%	3%	–1.9%	8.8%	68%	44
3,200	50%	5%	4%	–2.0%	9.1%	71%	46
3,200	50%	5%	5%	–2.1%	9.5%	73%	47
3,200	50%	5%	6%	–2.1%	9.9%	76%	49
3,200	50%	5%	7%	–2.2%	10.1%	78%	50
3,200	50%	5%	8%	–2.3%	10.4%	81%	52
3,200	50%	5%	9%	–2.3%	11.0%	84%	54
3,200	50%	5%	10%	–2.4%	11.0%	86%	55
3,200	50%	5%	11%	–2.5%	11.3%	90%	58
3,200	50%	5%	12%	–2.5%	11.6%	93%	60

Table D.2—continued

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS	Percentage Increase in ARP	Estimated ARP Budget Increase (in millions of 2015 dollars)
3,200	50%	5%	13%	–2.6%	11.8%	96%	62
3,200	50%	5%	14%	–2.6%	12.0%	100%	64
3,200	50%	5%	15%	–2.7%	12.3%	103%	66
3,200	50%	5%	16%	–2.7%	12.5%	107%	69
3,200	50%	5%	17%	–2.7%	12.6%	110%	71
3,500	60%	0%	1%	–2.3%	10.5%	66%	43
3,500	60%	0%	2%	–2.4%	10.9%	69%	44
3,500	60%	0%	3%	–2.4%	11.2%	73%	47
3,500	60%	0%	4%	–2.5%	11.6%	76%	49
3,500	60%	0%	5%	–2.6%	12.0%	80%	52
3,500	60%	0%	6%	–2.7%	12.2%	84%	54
3,500	60%	0%	7%	–2.7%	12.6%	89%	57
3,500	60%	0%	8%	–2.7%	13.1%	92%	59
3,500	60%	0%	9%	–2.8%	13.0%	96%	62
3,500	60%	0%	10%	–2.9%	13.3%	100%	64
3,500	60%	0%	11%	–2.9%	13.5%	103%	66
3,500	60%	0%	12%	–3.0%	13.7%	108%	70
3,500	60%	0%	13%	–3.0%	13.9%	113%	73
3,500	60%	0%	14%	–3.1%	14.1%	116%	75
3,500	60%	0%	15%	–3.1%	14.2%	121%	78
3,500	60%	0%	16%	–3.1%	14.4%	125%	81
3,500	60%	0%	17%	–3.2%	14.6%	130%	84
3,500	60%	1%	0%	–2.2%	9.9%	65%	42
3,500	60%	1%	1%	–2.2%	10.3%	68%	44
3,500	60%	1%	2%	–2.3%	10.7%	71%	46
3,500	60%	1%	3%	–2.4%	11.0%	74%	48
3,500	60%	1%	4%	–2.5%	11.5%	78%	50
3,500	60%	1%	5%	–2.6%	11.8%	82%	53
3,500	60%	1%	6%	–2.6%	12.1%	85%	55
3,500	60%	1%	7%	–2.7%	12.4%	90%	58

Table D.2—continued

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS	Percentage Increase in ARP	Estimated ARP Budget Increase (in millions of 2015 dollars)
3,500	60%	1%	8%	–2.8%	12.7%	93%	60
3,500	60%	1%	9%	–2.8%	13.0%	98%	63
3,500	60%	1%	10%	–2.9%	13.2%	102%	66
3,500	60%	1%	11%	–2.9%	13.3%	105%	68
3,500	60%	1%	12%	–3.0%	13.6%	110%	71
3,500	60%	1%	13%	–3.0%	13.8%	114%	73
3,500	60%	1%	14%	–3.0%	14.0%	118%	76
3,500	60%	1%	15%	–3.1%	14.0%	123%	79
3,500	60%	1%	16%	–3.1%	14.2%	127%	82
3,500	60%	1%	17%	–3.1%	14.4%	131%	84
3,500	60%	2%	0%	–2.1%	9.8%	67%	43
3,500	60%	2%	1%	–2.2%	10.1%	70%	45
3,500	60%	2%	2%	–2.3%	10.6%	73%	47
3,500	60%	2%	3%	–2.4%	10.9%	76%	49
3,500	60%	2%	4%	–2.5%	11.3%	80%	52
3,500	60%	2%	5%	–2.6%	11.5%	84%	54
3,500	60%	2%	6%	–2.6%	12.0%	88%	57
3,500	60%	2%	7%	–2.7%	12.2%	91%	59
3,500	60%	2%	8%	–2.7%	12.5%	95%	61
3,500	60%	2%	9%	–2.8%	12.8%	99%	64
3,500	60%	2%	10%	–2.8%	13.0%	103%	66
3,500	60%	2%	11%	–2.9%	13.3%	107%	69
3,500	60%	2%	12%	–2.9%	13.4%	112%	72
3,500	60%	2%	13%	–3.0%	13.6%	116%	75
3,500	60%	2%	14%	–3.0%	13.8%	120%	77
3,500	60%	2%	15%	–3.0%	13.9%	124%	80
3,500	60%	2%	16%	–3.1%	14.1%	129%	83
3,500	60%	2%	17%	–3.1%	14.2%	133%	86
3,500	60%	3%	0%	–2.1%	9.6%	68%	44
3,500	60%	3%	1%	–2.2%	10.0%	72%	46

Table D.2—continued

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS	Percentage Increase in ARP	Estimated ARP Budget Increase (in millions of 2015 dollars)
3,500	60%	3%	2%	–2.3%	10.4%	75%	48
3,500	60%	3%	3%	–2.3%	10.7%	78%	50
3,500	60%	3%	4%	–2.4%	11.1%	82%	53
3,500	60%	3%	5%	–2.5%	11.5%	86%	55
3,500	60%	3%	6%	–2.6%	11.8%	90%	58
3,500	60%	3%	7%	–2.6%	12.1%	94%	61
3,500	60%	3%	8%	–2.7%	12.4%	98%	63
3,500	60%	3%	9%	–2.8%	12.6%	102%	66
3,500	60%	3%	10%	–2.8%	12.9%	106%	68
3,500	60%	3%	11%	–2.9%	13.1%	109%	70
3,500	60%	3%	12%	–2.9%	13.3%	113%	73
3,500	60%	3%	13%	–2.9%	13.4%	117%	75
3,500	60%	3%	14%	–3.0%	13.6%	121%	78
3,500	60%	3%	15%	–3.0%	13.8%	126%	81
3,500	60%	3%	16%	–3.1%	13.7%	130%	84
3,500	60%	3%	17%	–3.1%	14.1%	135%	87
3,500	60%	4%	0%	–2.1%	9.5%	70%	45
3,500	60%	4%	1%	–2.2%	9.9%	74%	48
3,500	60%	4%	2%	–2.2%	10.3%	77%	50
3,500	60%	4%	3%	–2.3%	10.7%	80%	52
3,500	60%	4%	4%	–2.4%	11.0%	83%	53
3,500	60%	4%	5%	–2.5%	11.4%	88%	57
3,500	60%	4%	6%	–2.5%	11.7%	91%	59
3,500	60%	4%	7%	–2.6%	11.9%	95%	61
3,500	60%	4%	8%	–2.7%	12.2%	99%	64
3,500	60%	4%	9%	–2.7%	12.4%	103%	66
3,500	60%	4%	10%	–2.8%	12.6%	108%	70
3,500	60%	4%	11%	–2.8%	13.0%	111%	71
3,500	60%	4%	12%	–2.9%	13.2%	115%	74
3,500	60%	4%	13%	–2.9%	13.4%	119%	77

Table D.2—continued

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS	Percentage Increase in ARP	Estimated ARP Budget Increase (in millions of 2015 dollars)
3,500	60%	4%	14%	–2.9%	13.5%	123%	79
3,500	60%	4%	15%	–3.0%	13.6%	128%	82
3,500	60%	4%	16%	–3.0%	13.8%	132%	85
3,500	60%	4%	17%	–3.0%	14.0%	136%	88
3,500	60%	5%	0%	–2.0%	9.4%	73%	47
3,500	60%	5%	1%	–2.1%	9.8%	76%	49
3,500	60%	5%	2%	–2.2%	10.2%	79%	51
3,500	60%	5%	3%	–2.3%	10.6%	82%	53
3,500	60%	5%	4%	–2.4%	10.9%	85%	55
3,500	60%	5%	5%	–2.4%	11.2%	89%	57
3,500	60%	5%	6%	–2.5%	11.5%	93%	60
3,500	60%	5%	7%	–2.6%	11.8%	97%	62
3,500	60%	5%	8%	–2.6%	12.1%	101%	65
3,500	60%	5%	9%	–2.7%	12.4%	105%	68
3,500	60%	5%	10%	–2.7%	12.6%	109%	70
3,500	60%	5%	11%	–2.8%	12.9%	113%	73
3,500	60%	5%	12%	–2.8%	13.1%	117%	75
3,500	60%	5%	13%	–2.9%	13.3%	121%	78
3,500	60%	5%	14%	–2.9%	13.5%	125%	81
3,500	60%	5%	15%	–3.0%	13.6%	129%	83
3,500	60%	5%	16%	–3.0%	13.7%	133%	86
3,500	60%	5%	17%	–3.0%	13.8%	138%	89
3,800	70%	0%	1%	–2.7%	12.2%	83%	53
3,800	70%	0%	2%	–2.7%	12.5%	88%	57
3,800	70%	0%	3%	–2.8%	12.8%	92%	59
3,800	70%	0%	4%	–2.8%	13.1%	97%	62
3,800	70%	0%	5%	–2.9%	13.3%	101%	65
3,800	70%	0%	6%	–3.0%	13.6%	106%	68
3,800	70%	0%	7%	–3.0%	13.9%	111%	71
3,800	70%	0%	8%	–3.1%	14.1%	116%	75

Table D.2—continued

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS	Percentage Increase in ARP	Estimated ARP Budget Increase (in millions of 2015 dollars)
3,800	70%	0%	9%	–3.1%	14.2%	121%	78
3,800	70%	0%	10%	–3.2%	14.4%	126%	81
3,800	70%	0%	11%	–3.2%	14.6%	131%	84
3,800	70%	0%	12%	–3.2%	14.8%	136%	88
3,800	70%	0%	13%	–3.3%	15.0%	141%	91
3,800	70%	0%	14%	–3.3%	15.2%	146%	94
3,800	70%	0%	15%	–3.3%	15.3%	152%	98
3,800	70%	0%	16%	–3.4%	15.5%	157%	101
3,800	70%	0%	17%	–3.4%	15.6%	162%	104
3,800	70%	1%	0%	–2.6%	11.7%	80%	52
3,800	70%	1%	1%	–2.6%	12.0%	84%	54
3,800	70%	1%	2%	–2.7%	12.3%	89%	57
3,800	70%	1%	3%	–2.8%	12.7%	93%	60
3,800	70%	1%	4%	–2.8%	12.9%	98%	63
3,800	70%	1%	5%	–2.9%	13.2%	103%	66
3,800	70%	1%	6%	–2.9%	13.4%	107%	69
3,800	70%	1%	7%	–3.0%	13.7%	113%	73
3,800	70%	1%	8%	–3.0%	14.0%	117%	75
3,800	70%	1%	9%	–3.1%	14.0%	122%	79
3,800	70%	1%	10%	–3.1%	14.3%	127%	82
3,800	70%	1%	11%	–3.2%	14.5%	132%	85
3,800	70%	1%	12%	–3.2%	14.7%	137%	88
3,800	70%	1%	13%	–3.2%	14.9%	142%	91
3,800	70%	1%	14%	–3.3%	15.0%	147%	95
3,800	70%	1%	15%	–3.3%	15.1%	153%	99
3,800	70%	1%	16%	–3.3%	15.3%	158%	102
3,800	70%	1%	17%	–3.4%	15.5%	163%	105
3,800	70%	2%	0%	–2.5%	11.5%	81%	52
3,800	70%	2%	1%	–2.6%	11.8%	86%	55
3,800	70%	2%	2%	–2.6%	12.1%	90%	58

Table D.2—continued

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS	Percentage Increase in ARP	Estimated ARP Budget Increase (in millions of 2015 dollars)
3,800	70%	2%	3%	–2.7%	12.6%	95%	61
3,800	70%	2%	4%	–2.8%	12.8%	99%	64
3,800	70%	2%	5%	–2.8%	13.0%	104%	67
3,800	70%	2%	6%	–2.9%	13.3%	108%	70
3,800	70%	2%	7%	–2.9%	13.5%	114%	73
3,800	70%	2%	8%	–3.0%	13.8%	118%	76
3,800	70%	2%	9%	–3.0%	14.0%	124%	80
3,800	70%	2%	10%	–3.1%	14.1%	129%	83
3,800	70%	2%	11%	–3.1%	14.3%	134%	86
3,800	70%	2%	12%	–3.1%	14.5%	138%	89
3,800	70%	2%	13%	–3.2%	14.6%	144%	93
3,800	70%	2%	14%	–3.2%	14.9%	149%	96
3,800	70%	2%	15%	–3.3%	15.0%	154%	99
3,800	70%	2%	16%	–3.3%	15.2%	159%	102
3,800	70%	2%	17%	–3.3%	15.4%	165%	106
3,800	70%	3%	0%	–2.4%	11.2%	83%	53
3,800	70%	3%	1%	–2.5%	11.6%	87%	56
3,800	70%	3%	2%	–2.6%	11.9%	91%	59
3,800	70%	3%	3%	–2.7%	12.3%	96%	62
3,800	70%	3%	4%	–2.7%	12.6%	101%	65
3,800	70%	3%	5%	–2.8%	12.9%	106%	68
3,800	70%	3%	6%	–2.9%	13.1%	110%	71
3,800	70%	3%	7%	–2.9%	13.4%	115%	74
3,800	70%	3%	8%	–3.0%	13.5%	119%	77
3,800	70%	3%	9%	–3.0%	13.8%	125%	81
3,800	70%	3%	10%	–3.0%	13.9%	130%	84
3,800	70%	3%	11%	–3.1%	14.1%	135%	87
3,800	70%	3%	12%	–3.1%	14.1%	139%	90
3,800	70%	3%	13%	–3.1%	14.4%	145%	93
3,800	70%	3%	14%	–3.2%	14.7%	150%	97

Table D.2—continued

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS	Percentage Increase in ARP	Estimated ARP Budget Increase (in millions of 2015 dollars)
3,800	70%	3%	15%	–3.2%	14.9%	155%	100
3,800	70%	3%	16%	–3.3%	15.0%	160%	103
3,800	70%	3%	17%	–3.3%	15.1%	166%	107
3,800	70%	4%	0%	–2.4%	11.0%	84%	54
3,800	70%	4%	1%	–2.5%	11.4%	89%	57
3,800	70%	4%	2%	–2.6%	11.8%	92%	59
3,800	70%	4%	3%	–2.6%	12.2%	98%	63
3,800	70%	4%	4%	–2.7%	12.4%	102%	66
3,800	70%	4%	5%	–2.8%	12.7%	107%	69
3,800	70%	4%	6%	–2.8%	13.0%	111%	71
3,800	70%	4%	7%	–2.9%	13.2%	116%	75
3,800	70%	4%	8%	–2.9%	13.5%	121%	78
3,800	70%	4%	9%	–3.0%	13.6%	126%	81
3,800	70%	4%	10%	–3.0%	13.8%	131%	84
3,800	70%	4%	11%	–3.0%	14.0%	136%	88
3,800	70%	4%	12%	–3.1%	14.2%	141%	91
3,800	70%	4%	13%	–3.1%	14.2%	146%	94
3,800	70%	4%	14%	–3.2%	14.5%	151%	97
3,800	70%	4%	15%	–3.2%	14.7%	156%	100
3,800	70%	4%	16%	–3.2%	14.9%	161%	104
3,800	70%	4%	17%	–3.3%	15.0%	167%	108
3,800	70%	5%	0%	–2.4%	10.9%	85%	55
3,800	70%	5%	1%	–2.4%	11.3%	90%	58
3,800	70%	5%	2%	–2.5%	11.6%	94%	61
3,800	70%	5%	3%	–2.6%	12.0%	98%	63
3,800	70%	5%	4%	–2.7%	12.4%	103%	66
3,800	70%	5%	5%	–2.7%	12.6%	108%	70
3,800	70%	5%	6%	–2.8%	12.9%	112%	72
3,800	70%	5%	7%	–2.9%	13.1%	117%	75
3,800	70%	5%	8%	–2.9%	13.3%	122%	79

Table D.2—continued

Number of Pilots Hired by Major Airlines (Baseline 1,700)	Probability of Major Airline Hire (Baseline 10%)	Net Percentage Increase in Civilian Non-Pilot Wage	Net Percentage Increase in Civilian Pilot Wage	Percentage Change in Force Size Before 20 YOS	Percentage Change in Force Size After 20 YOS	Percentage Increase in ARP	Estimated ARP Budget Increase (in millions of 2015 dollars)
3,800	70%	5%	9%	–2.9%	13.5%	127%	82
3,800	70%	5%	10%	–3.0%	13.7%	131%	84
3,800	70%	5%	11%	–3.0%	13.8%	137%	88
3,800	70%	5%	12%	–3.1%	14.0%	142%	91
3,800	70%	5%	13%	–3.1%	14.2%	147%	95
3,800	70%	5%	14%	–3.1%	14.4%	151%	97
3,800	70%	5%	15%	–3.2%	14.5%	157%	101
3,800	70%	5%	16%	–3.2%	14.7%	162%	104
3,800	70%	5%	17%	–3.2%	14.8%	168%	108

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